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AEROSPACE

New Manufacturing Techniques for Ariane V Rocket

High-Speed Machining

92WS0628A Paris TECHNIQUES ET EQUIPEMENTS DE PRODUCTION in French May 92 p 14

[Article entitled: "High-Speed Machining for Ariane V"; first paragraph is TECHNIQUES ET EQUIPEMENTS DE PRODUCTION introduction]

[Text] Aerospatiale has acquired a new portal milling machine made by Henri Line. The miller has two 60-kW, 10,000-revolution broaches with central sprinkling systems, and will machine structural panels spanning 6 x 3 meters.

Aerospatiale has just had Henri Line build a 4-meter-pass portal machine to use in manufacturing the new generation of Ariane V tank panels. The machine has two very powerful, Fischer high-speed broaches (10,000 rev/min) that operate at 60 kW continuously and up to 75 kW intermittently. "It is the only miller of its kind in Europe," says Rene Serre, who is in charge of methods at Aerospatiale's Mureaux factory. "High-speed machining of such large pieces (maximum format is 3 x 6 meters) with broaches that powerful is an innovation in itself. But the real feat is the way the cutter bars are designed. Central irrigation—thus far reserved for piercing and drilling—is used for the first time in a milling application."

The value of the technique is obvious. "At high speeds, an outside sprinkler system is, in practice, useless and impossible. Centrifugal force repels the liquid. Here the lubricant is at the heart of the machining." The quality of the cut improves as a result. According to Alain Auffret—the technical director of Precise France, which represents Fischer in France—central irrigation creates a mist that mixes with the machining chips. That should make it easier to suction the chips and lubricant, which is done at the broach. "Better yet," adds Rene Serre, "it increases suction power. At high speeds, outside sprinkler systems ordinarily require manufacturers to cut back power to leave a little lubricant on the part. Such reductions will no longer be useful, and we should suction off 99.9 percent of the chips, instead of 60 percent." The last—and not least—of the advantages of central irrigation is that it substantially increases the life of the tool (Aerostel milling tips, screwed onto mills with average diameters of 80 mm). The two broaches owe their technical performance to Fischer's use of a ceramic rotary joint, developed by the German company Ott and Fischer. "The joint is engaged, starting at 4 bars, by the liquid's pressure (which can reach 100 bars)," explains Jean Kwapisz, Henri Line's technical director. The joint is integrated into a traction cartridge of the ISO 50 cone developed by Ott and Fischer. The cone continuously pulls 2.3 metric tons, instead of the standard 1 or 1.5. Two integrated inspection systems were installed to insure quality and precision. One is a Renishaw tracer, built into the broach, to detect blanks and inspect the part during and at the end of the machining process. The other, which occupies a fixed position on the head, is an integrated ultrasound inspection system. It measures the thickness of the panels, which span 18 square meters and are 1 mm thick.

The aluminum's 3 to 6 meters/min rate of feed cuts chip time by two-thirds. The miller has two working ranges (one for loading in concealed time) and its two milling heads can machine in parallel or symmetrical mode. "The overall gain in productivity will be 30 percent," Rene Serre estimates. "In the future, the new miller will probably machine all the large and medium-size parts (panels, fittings, and spars)." Indeed, the methods manager expects to "take over some of the workload of the airplanes division."

Factory for Booster Nozzles

92WS0628B Paris TECHNIQUES ET EQUIPEMENTS DE PRODUCTION in French May 92 pp 67-70

[Article by Daniel Chabbert: "SEP Custom-Makes a Factory for Ariane 5"; first paragraph is TECHNIQUES ET EQUIPEMENTS DE PRODUCTION introduction]

[Text] The European rocket's enginemaker opted to build a factory to mass-manufacture the booster nozzles for the future version of Ariane. The plant concentrates the company's high-tech know-how in place and optimizes automation and flow management.

"It is the first factory to combine all our specialized tasks," says Yvon Chouillou, who is the production manager of the booster nozzle factory (BNF) at the European Propellent Company's (SEP) Bordeaux manufacturing site.

The plant cost 160 million French francs [Fr], including Fr115 million for the specific equipment and hardware underwritten by the European Space Agency. It should reach its cruise speed of 16 nozzles a year in 2001. At that point the BNF will employ 100 people, and manufacture a complete nozzle in one year.

The European Propellant Company specializes in space propulsion systems (Ariane 4 and 5 engines, satellite propulsion systems) and weapons (powder boosters for missiles). It also has many years of experience developing and producing composite materials for civil and military use.

The company employs over 4,000 workers at four different sites: Suresnes and Villaroche near Paris, Vernon in the Eure, and Bordeaux. SEP racked up over Fr4.6 billion in sales in 1991.

Since the traditional method of organizing production—a different building for each specialty—would not work

for the standardized manufacture of future Ariane 5 versions, the European Propellant Company decided in 1988 to build its first factory wholly dedicated to one product. The BNF thus consists of a series of task-specific modules or shops, with different temperature, hygrometric, dust, and safety constraints, that span 11,000 square meters.

Optimizing the Flow of Personnel and Parts

"We opted for a cross layout to optimize the flow of personnel and parts inside the building and make it easy to expand the plant in three possible directions if necessary," explains Yvon Chouillou.

One of the branches comprises the warehouse, which is split into two sections by a central corridor. One half is reserved for the automated vertical storage of parts under 4,000 kilos in a 200-compartment pallet system. The other, heavier parts are housed horizontally in the second area. A bar code on the pallets identifies the type of part by its ID number, theoretical weight, height, and diameter. A special transfer car hauls the parts and tools into the factory. Simpler to manage than a wire-guided car, it is driven by a man aboard, who uses a video system to control the final approach to the module transfer stations. The higher the part's cost, which varies from several thousand to Fr22 million for a finished nozzle, the more precautions are taken in moving it.

The first task is to move the tools supporting the coiled parts (a skilled job that will be transferred to the factory only in 1993) into the first module, which polymerizes the composite blanks. Parts spend 20 hours in an autoclave, following which the density of their material is checked in a simple vat (the Archimedes principle). The tools are then cleaned in a degreasing chamber and returned to the warehouse, while the parts are sent to the machining module. For now, the machine shop consists of a vertical lathe with a 3.5-meter-diameter supporting table and machining height of 2 meters. A second palletized lathe will soon be added. A Renishaw tracer inspects both tools and parts. To machine the composite materials, SEP uses carbide tips coated with polycrystalline diamond. Cutting speed runs as high as 100 to 150 meters/min and depth of cut from 1 to 3 mm. Because the machining generates a lot of dust, a suction system has been placed to the right of the tool. In addition, a special machine with four digitized axes makes all the holes to degas the materials of such parts as the deflector, cone, and nose. A broach rotating at the rate of 15,000 rev/min makes the 3-mm-diameter holes to a depth of 25 to 40 mm. It is equipped with a two-holed drill bit that expels air under 12 bars of pressure. The process expels the dust—which is then suctioned to the outside—and cools the tool. "The drill makes 300 holes, compared to only two with a standard tool. It's a substantial gain, considering that a complete nozzle has 9,000 of that kind of hole," says Yvon Chouillou. Nonetheless, a tracing is made after each bore to check whether the tool is present.

In the next phase, X-rays are used to check for possible separations or cracks in the composite blank. The X-raying is done in a room buried 8.5 meters underground, surrounded by one-meter-thick concrete walls and closed by a 30-ton lead door. (Eleven million electron volts of power are used.) Since all the composite parts must be inspected, the X-ray module is gradually becoming a bottleneck. To speed up the process, the BNF plans to invest soon in an X-ray tomography system that will enable technicians to view the parts in real time, without developing radiography negatives as they do now.

After inspection the composite parts, together with metal parts made by an Italian firm, are sent to the surface-preparation module. The surface-prep shop consists of a degreasing/washing room, a sanding/polishing room in a first section, and a painting/coating room in a second, separated by a lock chamber. A man operating a ferry transfers the parts from one work station to another. The ferry also takes the parts to two clean rooms: one for tape laying of the stop, and the other for bonding. In the first module, elastomer plies are cut and tape laid onto a metal frame, then put into a polymerisation oven to make the flexible stop. An air-cushioned car moves the parts between the different stations. After the flexible stop is molded in a different module that contains a 1,200-ton-pressure hot press (200°C), it is checked for rigidity and sent to another shop. There a test bench runs deflection and tensile stress/compression tests.

Two stations are now operating in the second clean room, which will eventually contain six. The first station bonds the nozzle extensions, and the second bonds the cone-equipped deflector, nozzle housing, and nose. The polymerization cycle lasts 48 hours under a 20-metric-ton press. The parts then travel through a lock chamber to a room where the quality of the bonding is inspected by ultrasound. The quality-control machine has a turntable and two masts that make 3,000 measurements per part.

The different nozzle subcomponents are assembled in final form in a last module that features three stations powered by an air-cushioned integration gantry. This crane, which is entirely controlled and run by automatons, is vital for positioning parts that weigh several metric tons to within one-hundredth of a millimeter. Insertion and tightening of the screws is also automated to control the torque and sequence of the bolting.

Finally, before the nozzle is shipped in a pressurized container to Kourou, it is bench tested to check the water tightness of the nose blanking plug (tape-laid rubber to prevent any moisture from traveling up to the boosters before takeoff), the dimensions of the nozzle, and functioning (activation).

To manage and monitor all the movements in the Booster Nozzle Factory, SEP has hooked up the machines and all the equipment to a local-area network that is connected to the company's central network.

"Our goal is zero paper," stresses Yvon Chouillou. "All manufacturing and inspection records will also be kept by the network."

Boxed Material: 3000°C Gases Moving 3,000 Meters/Sec

SEP's nozzle weighs 6.2 metric tons, is 3.4 meters high, and has a diameter of 2.8 meters at the nozzle-cone outlet. Its job is to generate and then direct thrust by causing the whole nozzle, mounted on a flexible stop, to pivot slightly using two actuators placed perpendicular to one another. The nozzle structure is made of steel and light alloys. Its cone and body are thermal shielded with carbon and phenolic silica and its neck with Novoltex carbon-carbon. The flexible stop is made of a steel/rubber laminate. When the nozzle is operating, gases will reach a pressure of 60 bars, a temperature of 3,000°C, and an ejection speed of 3,000 meter/sec at the nozzle outlet.

Germany To Build Record-Range Environment Research Aircraft

92MI0633 Bonn DIE WELT in German 4 July 92 p 9

[Article by Anatol Johansen: "A New German High-Altitude Plane Beats Legendary American Long-Distance Reconnaissance Plane—Strato 2C Set To Break Airplane Records From 1995"]

[Text] There has never yet been an airplane capable of flying for up to 50 hours without refueling, at a height of 24 kilometers. Such a plane is now to be built, on the orders of Federal Research Minister Heinz Riesenhuber: its uses will include atmospheric research into the ozone layer.

The 80.4 million German marks [DM] contract for this superplane has been awarded to Grob, a company based in the southern German town of Mindelheim enjoying a longstanding worldwide reputation for light aircraft, particularly gliders. Grob, with previous production totalling over 3,000 planes, intends to use state-of-the-art technology to achieve the exceptional performance expected on the new Strato 2C.

Firstly, the plane's weight has to be extremely light, despite its exceptional dimensions: its 56.6 meter wingspan is similar to that of a Boeing 747 jumbo jet. Yet, without fuel and useful load, the plane weighs only 5.8 tonnes, compared with a fully-laden jumbo's takeoff weight of 180 tonnes.

This extremely light weight is made possible by the use of fiber composites, which combine extreme lightness with great strength and bearing capacity. Grob is taking the technology of glass fiber, carbon fiber and aramide fiber-reinforced plastics, developed for high-performance gliders, power gliders and the Strato 1 research plane, a logical step further; in addition to their light structure, such materials have the advantage over metal of being non-corrosive and almost free of material fatigue.

Special qualities were also required for the aircraft's engines. For a number of reasons, including the extreme light weight and minimum possible fuel consumption required, propeller engines were essential. Unfortunately, normal turboprop engines have a great disadvantage, as their performance falls off rapidly at higher altitudes.

For this reason, the Strato 2C's two piston engines, each of which produces only 300 KW (around 400 HP), are equipped with both a turbo-supercharger and a reducing gear system, enabling heights of up to 24 kilometers to be reached with constant engine power.

The two pilots and two scientists comprising the Strato 2C's crew will not suffer from the extremely high altitudes. Unlike other high-altitude research planes, they will not be crammed into uncomfortable pressure suits, as the plane has a relatively spacious pressurized cabin, providing a sizeable high-altitude working environment. Besides atmospheric research, the Strato 2C can also be used for monitoring large-scale air and water pollution, remote observation of the earth's surface, for example in searching for hitherto undetected raw materials or fresh-water supplies, or monitoring pest incidence in fields and forests, and even for air safety functions over the North Atlantic or warning ships of ice. The plane's maiden flight is scheduled for 1995, from the German Aerospace Research [DLR] Agency's airfield at Oberpfaffenhofen, near Munich.

Hermes Program Costs, Alternatives Discussed

92WS0651A Duesseldorf VDI NACHRICHTEN in German 29 May 92 p 3

[Article by Wolfgang Mock: "No Money for Manned Space Flight, Hermes Finally Threatened With Political End"—first paragraph is VDI NACHRICHTEN introduction]

[Text] Duesseldorf, VDI-N—The [space] industry wants to economize in the short run and cooperate with GUS in the long run. A new concept of joint manned space flight is at present being honed throughout Europe. The federal government wants to rigorously economize and the industry is trying to save what can be saved. But the Hermes space glider is as good as written off.

Employees of the European Space Agency (ESA) in Paris are at the moment working under great pressure on a new space program. At the last meeting of European ministers for space last fall in Munich, ESA chief Jean-Marie Luton was criticized by the assembled ministers of the ESA member countries for budgeting too much money over too long a period and for cooperating too little with the new eastern European democracies, especially the space superpower, Russia.

The plan must be ready by the end of June. The ESA ministers want to meet again in Madrid in November. And they will need at least three months to make the new plans and especially to make the necessary costs palatable to their governments.

Since the European space program has been threatened with failure due to lack of money for years now. In 1987 the ministers of the ESA member countries responsible [for the space program] agreed to build a common space infrastructure with its own booster rocket, the Ariane 5, for the Hermes space glider and a European space laboratory, Columbus, in part docked to the U.S. space station, Freedom, and in part freely flying in space.

Organizational problems and continual new technological outlays for the projects rapidly drove costs up: The space glider, which it was estimated in 1987 would cost DM8.5 billion, costs DM14.7 billion at today's prices and the components of the European space station, Columbus, have risen in cost from DM7.4 billion to over DM10 billion. The Germans have constantly urged the ESA to economize and tried to lower annual costs through an extension of the timetable.

"Nevertheless," as it was put in a Federal Research Ministry (BMFT) report made in early May, "the funds required of Germany for the middle term were so extensive that the federal government could not see its way clear to making these funds available." The federal government would lack nearly DM5 billion until the year 2000 for the financing of common European space objectives.

"A complete Hermes program," Joerg Fenstel-Buechl, who is now also responsible for space-transport technology in the ESA, admitted, "is no longer possible."

There are at present three alternative plans in the ESA's drawer:

1. Construction of an Hermes flight model of the original size by the year 2000, but without the life-support systems necessary for manned flight. With this alternative, launch, reentry into earth's atmosphere, and landing can be simulated. The cost saving vis-a-vis the old Hermes plan, according to Feustel-Buechl: from 60 to 70 percent.

2. Construction of a European rescue vehicle for the U.S. Freedom space station.

3. Development of a technology program in which the flight properties of Hermes would be tested with smaller models.

All three ideas will be replaced by the proposal for an intelligent advanced version of the Ariane 5, by means of which the latter will be able to automatically dock to the Freedom space station (ATV [Ariane Transfer Vehicle]).

The ESA is currently staking everything on the first alternative, the Hermes flight model. "A very hot candidate," Feustel-Buechl remarked.

Less so, however, for the federal government: "This alternative," it says in the BMFT report, "is still considerably beyond Germany's ability to finance it, according to the situation with current decisions, despite the distinct savings it would afford us."

No Money for Even a Minimal Program

The federal government wants to make DM1,133 billion available for the financing of ESA plans in 1992. These funds are supposed to be annually increased at the rate of 2.5 percent until 1995, at which point they will probably be frozen at that level. "I cannot, of course, go into any commitments that go beyond these," Federal Research Minister Heinz Riesenhuber warned Jean-Marie Luton as early as the end of December 1991. Luton had called for, at least, DM100 million higher basic contribution for the German contributions for 1992 and an annual rate of increase of 10 percent until the year 2000.

This is a threatening development for the industry. After the hard landing of the Jaeger [Hunter] 90, funds for space flight will probably be cut back now too. Daimler president Edward Reuter and the president of the Daimler subsidiary, German Aerospace (DASA), Juergen Schrempp, had presented Riesenhuber with their strategy at the end of March. Like ESA, DASA wants to further develop Hermes as an unmanned "technology demonstrator" on a scale of 1:1, as well as the docked module for the space station and the polar platform intended for observations of earth. So, after 1998-2000, cooperation with GUS states will probably have progressed so far that they can consider close cooperation on the further development of Hermes as well as of a common free-flying space station. According to DASA space director Werner Heinzmann, there is the "closest possible" agreement with the French industry on this plan.

The industry estimates that, with this diluted and trimmed down plan, not only can the number of experts working on the Hermes and Columbus projects be "approximately maintained" (Heinzmann), but the coverage gap in the federal economy until the year 2000 can be reduced from nearly DM5 billion to barely DM1.5 billion. The deficit amounts to: from DM200 million to DM300 million a year. And Heinzmann said that this would not be much to pay to "avert a sizable threat to the German space industry."

At the moment only one thing is obvious in Bonn: "It cannot be financed within the framework of finance planning." This is the position taken by the Ministry of Research. And the industry can also expect little from the Social Democratic opposition. "With this, the dream of an independent European space industry," SPD [Social Democratic Party of Germany] Bundestag member Edelgard Bulmahn commented on this development without shedding many tears, "is probably over."

Dual Production of Airbus Fuselage Planned

92WS0651B Duesseldorf VDI NACHRICHTEN in German 29 May 92 pp 1, 33

[Article by Norbert Schmidt: "Dual Production Method: Quickly Assembled Airbus Fuselage"—first paragraph is VDI NACHRICHTEN introduction]

[Text] Duesseldorf, VDI-N—As concerns efficiency, the production engineers at the MBB [Messerschmitt-Bolkow-Blohm] plant in Augsburg had to dream up something special. Because this year they expect to produce more Airbus fuselage parts than previously with production costs simultaneously lowered, according to their ambitious claim. The Augsburg engineers are now mass-producing a large variety of fuselage sections—in a highly automated and flexible way. A dual-assembly method was developed which is divided into two operations: the construction of the prestored fuselage shell, which is used for all models, and four Airbus-specific assembly lines. Since the improved riveting machines are arranged in the same way during construction of the fuselage shell, any shell segment whatsoever can be riveted by any machine—NC [numerical control]-controlled and nine times faster than before.

Fast Riveting Machines Speed Up Mass Production in Aircraft Construction

Augsburg, VDI-N—Engineers in the Augsburg plant of the MBB, a German Aerospace company, have killed two birds with one stone: On the one hand, more Airbus fuselage parts had to be produced. At the same time, costs had to be lowered since its competitor, Boeing, is applying the pressure of competition to prices. The Augsburg production engineers are now mass-producing—in a highly automated and flexible way—a varied assortment of different kinds of aircraft modules.

Necessity is the mother of invention: "How can different fuselage parts that have up to now been manufactured at stationary work stations be automatically assembled in future?" Those responsible [for production] in Augsburg asked themselves this question after they were told that they clearly had to increase production as of 1992. Since, despite the current lull in the market, the Airbus company wants to increase its medium-term ability to deliver monthly from eight to 10 units of the A-320 series and from seven to 10 units of the big Airbus, a goal that could only be economically realized with a new, more productive assembly method. Especially when the number of units produced is subject to considerable cyclical fluctuations.

Based on the method developed at the Einswarden plant, which consists mainly of the production of cylindrical modules, the tail section of the aircraft, a tapering component which creates additional shaping problems because of its complicated doubly curved geometry, is manufactured in Augsburg.

According to the old production method, for this kind of work highly specialized experts were required who assembled the fuselage components in stationary assembly devices designed for specific components—the experts speak in the tradition of the old Bau-Hellingen airships. In the Bau-Hellingen the fuselage sections, made of extruded, edged sheet metal for planking, and various components of the interior structure were until now produced slowly step by step and above all, to large extent, manually, in connection with which the component geometry was established by working on the Bau-Hellingens.

This is exactly where they tackled the problem: New methods had to be created that would enable them to streamline fuselage assembly. "We analyzed all the processes and operations involved in the manufacturing process and broke them down into elements that are amenable to a homogeneous production methodology," as Doctor of Engineering Karl-Georg Plingen, the head of the production department of the MBB aircraft division, described it, "in order to be able to identify the same or similar operations and combine them."

On the basis of these considerations, a dual-assembly method was developed that divides operations by part family into a shell-construction section that is neutrally organized with respect to the product and into reorganized, product-specific assembly lines for the assembly of fuselage sections for different aircraft models.

Composed of the equipment stations, a buffer memory unit, and a flexible riveting area with six NC [numerical control] riveting machines, the product-neutral shell-construction section precedes the four specific assembly lines—fuselage and tail for the small Airbus, fuselage and tail for the big Airbus, underside of the fuselage, and keel support—on the production line. First, the "picture of the holes" previously constructed by means of flexible NC programs—the individual parts, that is, planking sheet metal with backing profile sections (stringers) and vertical connectors (clips) for them—are positioned and fastened to each other in the equipment area on the basis of holes positioned for specific components. This is not effected by means of numerous stationary devices each of which is for one model, as is otherwise customary, but by means of workpiece carriers that are independent of the model in question (multitooling). These at the same time serve as standardized normal pallets which are then spread out on one of the six riveting machines.

Since all the riveting machines are laid out in the same way, practically any partial shell can be riveted on any machine. Production planning provides the appropriate NC program via the DNC [direct numerical control] link. The operational scope of the standard riveting machines could clearly be expanded through further purposeful development of the machines so that even the processing of shells with complicated shapes up to 7.5 m x 4.2 m in size and a maximal curvature radius of 1.5 m is possible. Reception of the pallet transport frame on the machine side can be handled when controlled in the

Z-axis, thus making it possible to attain the optimal work position in relation to the riveting tool. With the help of these machines, 85 percent of all the rivets of the complex fuselage shells to be assembled can be driven in automatically and nine times faster than before, which brings with it a distinct increase in productivity and hence the ability to compete with manual riveting. Furthermore, the use of automatic riveting machines results in a distinct reduction in noise and is an important contribution to the ergonomic shaping of the workplace.

With this method for constructing the fuselage, they have succeeded in achieving a high degree of automation through complete integration of the work stations into the flow of materials and information. A hierarchical computer system composed of guidance, cell, and machine-control computers regulates the entire flow of materials through a driverless transport system as well as overhead suspension and crane-track systems.

The product-specific assembly lines could also be substantially more efficiently organized than they were before through this computer-supported reorganization, that is, the removal of the entire production of fuselages from the overall volume of work. In this way, contrary to the way production has been organized up to now, into individual, cyclical assembly lines, the volume of work can also be better distributed and automated.

Industry Proposes Two-Stage Development Program for Hermes Spaceplane

92WS0660A Paris LE MONDE in French 24 Jun 92 p 11

[Text] European manufacturers at the Berlin Aeronautics and Space Show just formed a company called Euro-Columbus to build a manned module for the space station Freedom. But Euro-Hermespace, the company which is responsible for the European spaceplane, is redoing its accounts and its timetable. The budget cuts requested by the member states of the European Space Agency (ESA) do not make it easy.

The ESA has scaled back its programs (see LE MONDE 28 May) and proposed that the original spaceplane be replaced by a more stripped-down demonstrator model, dubbed X-2000, six months before the scheduled conference of European ministers in Spain. Euro-Hermespace was forced to accomodate itself to the agency's choices, and has defined a two-stage development program.

An Automated Orbital Flight by 1999

The first stage will begin this year and will develop a scale 1 Hermes spaceplane. The vehicle will be equipped with all the functions needed for launch by the Ariane 5, atmospheric reentry, and landing.

The demonstrator model will make an automated orbital flight after a string of subsonic flights with a carrier plane beginning in 1999. The second stage of the program, which will stretch from 2000 to 2005, will develop all the technologies needed for manned flights: life in orbit, rendez-vous, stowing, space walks, and so on. Thus, the Hermes spaceplane may fly in operational configuration by the middle of the next decade.

Will the agency ratify this plan, which was presented in Berlin? The first clue should come this week, from an ESA council meeting that could prompt a later decision to launch the first stage of the demanding program late next year in Spain.

France: ONERA Inaugurates Hypersonic Wind Tunnel

92WS0661V Paris LA LETTRE HEBDOMADAIRE DU GIFAS in English 11 Jun 92 p 2

[Article: "ONERA Inaugurates Its New F4 Hypersonic Wind Tunnel"]

[Text] On 11 June, Yves Sillard, France's Delegate General for Armament Matters inaugurated the new F4 wind tunnel of ONERA at the Fauga Mausac Center in the vicinity of Toulouse. The new hypersonic tunnel will be used to probe aerothermic phenomena occuring during re-entry into the earth's atmosphere. Special stress will be placed on the effects of real gases. The tunnel can simulate speeds of around Mach 20, 20 times the speed of sound (approximately 22,000 km/hr). The F4 tunnel operates on gas heated to a high temperature and brought to a very high pressure by applying an intense electric arc. This gas is then expanded in a duct where it assumes the speed of several kilometers per second. Measurements are made by a detailed analysis of flow around the mockup, thereby indicating flow under true flight conditions. Building of the F4 was decided as part of the Hermes space shuttle program but it will be used in a large context, for the analysis of very high speeds.

G1 - ONERA - 11-6-1992 - Contact: Mr. S. Baume - Phone: 33 (1) 46 73 40 27

Norway: Plans for Satellite Launching Site at Andoya

92WS0663A Oslo AFTENPOSTEN in Norwegian 26 Jun 92 p 12

[Article by Rolf L. Larsen: "Andoya May Become West Europe's Space Center"]

[Text] Andoya could become Western Europe's Cape Canaveral. The island may be the European launch base for small advanced satellites. These satellites will monitor the earth's environment and study the atmosphere and the northern lights.

This space service could be the outcome of a Norwegian-Swedish cooperation to be called the Nordic Satellite Service.

"We will soon sign a cooperation agreement with the Swedish Space Corporation that will involve looking into the possibilities of building and operating Western Europe's first launch base on the island of Andoya. The base will cost around 100 million kroner. Our aim is to launch six satellites a year. They will move in low orbits over the poles. In other words at an altitude of between 200 and 800 kilometers," said administrative director Pal Sorensen of the Norwegian Space Center. The center coordinates Norwegian space activity and has around 70 employees in Oslo, Tromso and Andoya.

Important Data

More and more people in industrial, research and administrative circles are interested in data from space for the purpose of developing and using new products in the areas of environmental technology, meteorology, electronics, biotechnology and medicine. Satellite data and images from space are becoming increasingly important in a number of areas.

Twenty-ton booster rockets carrying satellites that weigh up to 250 kg could roar into space from Andoya within just a few years. Space experts regard the island as ideal for launching booster rockets. The ocean is right offshore and the route from there to the North Pole is relatively short. In their polar orbits the satellites will pass over the poles 14 times a day during each revolution of approximately 100 minutes.

Ground Stations

The existing ground stations in Tromso and Kiruna for recording data from satellites are ideally located. They can "see" 10 of the satellites' 14 overflights and thus pick up the data the satellites transmit from assignments in space. The Norwegian Space Center is also considering building its own ground station on Svalbard to pick up satellite data. A ground station located so far north could "see" all 14 overflights in the polar orbits.

Today the Tromso satellite station is the world's fastest station for recording and transmitting image data to users in this area. Conditions in Kiruna are also good in the area of image processing. Both stations could provide satellite data to customers around the world.

Space Transport

Plans call for adding a launch pad for booster rockets at the Oksebasen launch field on Andoya. New laboratories for assembling the booster rockets and installing the satellites must also be built. The first launch phase will be supervised from Andoya, then Sweden's rocket center in Kiruna will take over the supervision and guidance of the satellites.

The Norwegian Space Center would be the main transporter of booster rockets and satellites into space. The center plans to work with the Swedish Space Corporation to find customers who want to have work carried out in space.

"In a typical situation a customer with a satellite will use us as a high-tech transport firm. We will find a suitable booster rocket and take the satellite up into the right orbit. The Swedes will have the main responsibility for monitoring the satellites from their rocket base and satellite control center—Esrange—outside Kiruna," said information director Per Torbo of the Norwegian Space Center.

Small Satellites

There are no satellite launch bases in Western Europe today. European satellites are launched from the European space base in Kourou, French Guiana in South America. The satellites here can weigh up to 4 tons and extremely large booster rockets are required to launch them. Each launch costs several hundred million kroner and it can take several years to plan and build these satellites.

Currently there is growing interest in small satellites. They are relatively easy to plan and develop and there is a shorter waiting period for launching them. In addition small satellites are less vulnerable than big ones both during launching and while they are in space.

Matra Readying Autonomous Space Exploration Robot

92WS0672D Paris ROBOTS in French 19 Jun 92 p 2

[Article entitled: "Adam To Take First Steps Soon in Toulouse"]

[Text] Like the advanced locomotion demonstrator Frastar 2 and the right-handed, remote-controlled, assisted demonstator Dato, Adam, a self-guided demonstrator, will take its first steps very shortly in Toulouse. Adam is part of the AMR [Advanced Mobile Robots] project that is in its finalization phase. The robot is supposed to guide itself autonomously, notably on the planet Mars. For Matra Marconi Space, demonstrating Adam's performance is a crucial step in the development of autonomous mobile machines in Europe. Set down in unknown and rough terrain studded with obstacles, Adam can seek a path that allows it to skirt the obstacles and reach its original objective without communicating with the control station. The demonstrator is the product of research performed at the Robot and Artificial Intelligence Unit of the CNRS/LAAS [National Center for Scientific Research/Laboratory for Automation and Systems Analysis], under the AMR program. Researchers plan to test the autonomous demonstrator under conditions similar to those found on planets. A mobile Soviet platform that had been used for civil security purposes and is similar to those installed at Chernobyl was delivered in December for [testing of] Adam's first steps.

UK/CIS: Rolls Royce in Tupolev Engine Venture

92WS0678B Brussels EUROPEAN AVIANEWS INTERNATIONAL in English Jun 92 p 6

[Text] Rolls-Royce is making headway in the CIS. Only shortly after the UK engine manufacturer announced it had joined the new Union of Aviation Engine Producers (ASSAD) in the Commonwealth of Independent States, Rolls-Royce launched a new joint stock company (British Russian Aviation Company, or BRAVIA) to handle production/sales of the RR-powered Tupolev TU-204 airliner. This 200-seat twinjet will be the first Russian airliner to gain international clearance with western engines. Two RB211-535 engines for the demonstration and certification programme are to be delivered soon, and the maiden flight is scheduled for July.

EC: ELFIN Laminar Flow Wind Tunnel Tests Described

92WS0678D Brussels EUROPEAN AVIANEWS INTERNATIONAL in English Jun 92 p 21

[Text] Wind tunnel tests have been carried out on a wing fitted with a boundary layer suction system, by ONERA (*Office National d'Etudes et de Recherches Aerospatiales*) at its headquarters in Modane, France. This wing was tested in a transonic wind tunnel with an eight metre diameter—the biggest in the world in this category. These tests took place within the framework of the BRITE/EURAM research programme into ELFIN [European Laminar Flow Investigation] laminar flow technology.

The Elfin programme is one of the most important of those included within the aeronautical wing of the BRITE/EURAM (European Research in Advanced Materials) research programme, which is financed by the European Community, and designed to improve the competitiveness of Europe's aeronautical industry. Deutsche Airbus in Hamburg is responsible for coordinating the project, in which 24 companies, research institutes and universities are participating.

Last November, in Amsterdam (see *Avianews,* January 1992), the first phase of this research work led to a flight test on a Fokker 100 twinjet. The aircraft's starboard wing surface was modified, in accordance with a technique that allows laminar flow.

Laminar flow technology is highly promising, as it has the potential to reduce aerodynamic wing drag. This can lead to a total drag reduction of around 20 percent on an airliner on which the wing, nacelles and empennage have been laminarised. On aircraft larger than the Fokker 100, due to the high Reynolds level and sweep angle, it is not possible to obtain a laminar flow without installing a suction device on the wing's boundary layer on up to 15 percent of the chord. The surface flow is then laminar up to 50-60 percent of the chord without additional suction. This laminar flow control technique is called Hybrid Laminar Flow (HLF).

The scale wing model (a 1:2 scale VFW614 wing) was tested up to Mach 0.75 and Reynolds numbers up to 18 million, and had a variable sweep angle range from 20° to 28°. In order to accommodate a larger sweep angle, suction is required on the wing's leading edge in order to ensure laminarity on Airbus-type aircraft.

While the Europeans have been carrying out this research, which is designed to develop a European laminar aircraft, the Americans have already taken a substantial lead in the field. In the spring of 1990, NASA carried out tests on a Boeing 757 fitted with laminar flow leading edges.

German Aerospace Industry Reviewed

Growing Ambitions

92WS0678E Brussels EUROPEAN AVIANEWS INTERNATIONAL in English Jun 92 p 30

[Text] German civil aviation can claim to have a long tradition, stretching back to 1891 and to the first glider flights by Otto Lilienthal ("the first man ever to fly") right up to the present, with the first twin-jet, wide-bodied Airbus A300. But today, Germany is showing that it has new ambitions for the development of its aerospace industry.

Germany's aeronautical industry has recently given birth to a new generation 30-seater aircraft, that is fast and comfortable—the Dornier 328. It has also contributed, with it partners in Airbus Industrie, to the production of the first European long-haul four-jet aircraft, the A340.

Another great wish for Germany is about to be realised, which is to be responsible for the final assembly of at least one airliner on German soil. The 125-seat Airbus A321 will be the first European airliner to be assembled in Germany. The fact that it has been named "the German Airbus" says a great deal about the ambitions of this country's aeronautical industry, which is now hot on the heels of the two European aerospace leaders, Britain and France.

Deutsche Aerospace now intends to become prime contractor for a complete civil programme. This has led to the "Regioliner" project, conceived together with its Italian and French partners. Nevertheless, since there is wide recognition that there are too many regional transport manufacturers and none of them have made any profits—despite excellent export results—DASA is aiming to take advantage of this opportunity to try to rationalise this sector in Europe. It is certainly true that competitors have tended to multiply in Europe over recent months, leading to a state of confusion that has had a negative effect on these companies.

With DASA having a 25 percent participation in the Fokker 100 programme, the Dutch manufacturer finds itself in the curious position of being at the centre of efforts by DASA to lead the Europeans towards an agreement, designed to create the equivalent of the

Airbus consortium for regional transport. There are questions as to whether the agreement DASA is currently negotiating with Fokker might be to the detriment of the Regioliner. That is very unlikely. It would appear that a compromise has been found. DASA may take a share (probably a majority) in Fokker when the capital is increased in this company. The Regioliner programme may itself be deferred for a few years, so as to allow the Dutch manufacturer to launch its Fokker 70.

In the engine sector, the situation is far more clear. Negotiations between DASA and BMW to associate the two German power plant manufacturers, MTU and BMW/Rolls, into a single engine programme for the Regioliner appear (provisionally) to have fallen through. BMW/Rolls confirms that these discussions have come to a halt, without success. And so this company will go ahead with the development of its BR 700, while being prepared to find an agreement at a later stage with MTU at the production stage.

As to the East of Europe, the Germans appear to be very interested and have in particular decided to do everything possible to associate Russian industry with European programmes—especially in the space sector, where the experience and capabilities of the latter in manned modules and space shuttles could prove very useful.

On a domestic level, Germany's aeronautics industry has been fairly successful in integrating the industrial capacities of the former East Germany. A good example is MTU's takeover of LTL in Ludwigsfelde, of DASA's acquisition of Jenoptik in Jena, and the takeover of FWD in Dresden by Deutsche Airbus. Their personnel have been quickly brought up to standard, to the extent that the Dresden plant is now working on the Fokker 100 fuselages. Moreover, the experience and contacts of these eastern German companies' managements and engineers with Russian industry are greatly appreciated by DASA, which naturally intends to benefit from them.

ILA, a Window on the East?

The last ILA show took place in Hannover, in May 1990. Two years later, Berlin is taking up the banner to welcome this first post-reunification aeronautical salon. Berlin is a symbolic place in more than just name, as this city is a forum for important meetings for both Germans and all Europeans, from the West to the East.

German Aerospace Industry (results for the period 1990-91)

Turnover: DM 25.372 million (+3% compared to 1989) of which exports: DM 10.3 million; of which R&D: DM 5.4 million

Personnel: 95.042 employees

(Source: BDLI)

Dornier, Airbus

92WS0678F Brussels EUROPEAN AVIANEWS INTERNATIONAL in English Jun 92 pp 31-33

[Text] The Dornier 328, which is the first aircraft to be produced as part of the DASA group, may also be the last aircraft to carry the name of the famous German constructor.

Launched in 1986, the development programme for this new generation 30-33 seat twin turboprop has gone smoothly from a technical viewpoint. Shortly after its presentation last autumn at Oberpfaffenhofen, where it is assembled by Dornier, the 328 made its maiden flight on 6 December 1991. Since then, this prototype has clocked up 63 flight hours (by 5 May), which are part of the programme of flight tests totaling 1100 hours, with a view to certification by the JAA in Europe (JAR 25) and the FAA in the U.S. towards the middle of 1993.

The second pre-production aircraft, in the colours of Horizon Air, was in the final assembly stage when we visited Dornier's factory at the beginning of May. This aircraft was to start flying during the month, in order to test the aircraft's systems and particularly, its avionics. A third aircraft will be used to test on-board systems, as well as de-icing tests, and it should fly in July. Lastly, at the end of August, a fourth DO328 will be produced, and will itself be used as a demonstrator as well as for carrying out some noise tests.

This programme is being realised as part of a cooperation: Daewoo in South Korea (21 percent share of the programme) is supplying the fuselage shells. Aermacchi in Italy (14 percent) the cockpit, and Westland Aerospace in Great Britain (5 percent), the engine nacelles. In total, these three partners represent 40 percent of the Dornier 328's manufacture, while the German company itself is responsible for the wing (similar to that on the 228), the rear fuselage and bulkhead.

The main equipment is American-made: Pratt & Whitney make the engines (PW119A), Honeywell, the avionics (Primus 2000) and Hartzell, the six bladed propellers. The French company ERAM, a subsidiary of Messier-Bugatti, is producing the landing gear, while Bendix supplies the brakes.

At this stage, it is already possible to say that Dornier has achieved all its objectives in terms of performance and comfort. Capable of a cruise speed of 345 KTAS (640 km/h) and a range of 700 nm (1300 km) at a maximum cruise altitude of 25,000 ft, the Dornier 328 will be the fastest in its category, thanks to its two PW119A power plants which develop 1815 shp thrust at takeoff. The PW119A, which has an identical compressor to that on the PW124, has a 10 percent growth potential. Moreover, a maximum thrust of 2180 shp is also available as an option, for operation on runways 2700 ft long (instead of the 3300 ft normally required). The "Improved Performance Kit" has already been ordered by the Swiss airline Air Engiadina.

Comfort has been a prime goal for the German engineers; Dornier wanted to build a turboprop that matched the sort of comfort normally associated with a jet. The cabin is one of the most spacious, to judge from its dimensions: 1.89 m high, and 2.18 m wide. As for the seats, they offer a generous pitch of 18.1 inches. Moreover, vibration and noise have been reduced as much as possible; in 75 percent of the cabin, the noise level does not exceed 78 db(A). That has been made possible by using a six-bladed propeller, designed by Hartzell according to Dornier's specifications, which gives a maximum efficiency of just 1050 RPM.

The cockpit is also ultra-modern. It offers digital avionics that are integrated with five CRT screens—Honeywell's Primus 2000 system—which is comparable to that found on the most modern of airliners (B747-400, A330/A340 and MD-11). The Honeywell system also offers many options like MLS, TCAS or GPS.

Another innovation found on the DO328 is the option of a Head-Up Guidance System like that which already equips Air Inter's Airbus A320s. This allows landings in CAT IIIA conditions. Horizon Air, the subsidiary of Alaska Airlines based in Seattle (Washington), has ordered this equipment from Flight Dynamics for installation on all its Dornier 328s.

Composite materials are also used for the manufacture of the DO328. They make up 23 percent of the aircraft's weight. For the first time on a civil aircraft, aramide fibres strengthened with carbon fibres are being used to manufacture the bulkhead separating the pressurised cabin from the aircraft's tail. However, Dornier has provisionally given up the idea of using aluminium-lithium, because this material is too expensive, due to the fact that no other manufacturer uses it at present.

Dornier 328

The Dornier 328 is one of the most modern regional transport aircraft of its generation, with regard to its performance, its cockpit avionics and the comfort of its cabin—which is the equal of the latest airliners.

Dornier is hoping to sell over 400 Dornier 328s, or around 40 percent of the potential 30-39 seat market, which is put at 1800 aircraft to be delivered between 1992 and 2006. At a dollar-rate of DM1.8, Dornier estimates this programme's breakeven point to be 360 aircraft sold. The total investment put into this programme is put at DM750 million (ECU370 million), and includes in particular the manufacture of a new assembly hall in Oberpfaffenhofen, near Munich. To date, over 70 aircraft have been sold (45 firm orders and 28 options), mainly on the North American market (50 percent). Initially, over 140 aircraft had been sold by Dornier, but the German constructor suffered a serious setback when its main customer, Midway Airlines of Chicago, went bankrupt at the end of last year (it had orders for 33 units, plus 40 options). Nor has Dornier received any orders since last year.

With European certification scheduled before the FAA's, the first production aircraft will be delivered to Sunshine Aviation in Switzerland, with the next going to Horizon Air of Seattle. The DO328's unit price stands at US$7.85 million (ECU6.5 million).

When the series production is launched, Dornier hopes to deliver 20 DO328 aircraft in 1993 and 30 in 1994. The constructor is capable of building up to five aircraft a month.

When it arrives on the market in mid-1993, the DO328 will no doubt—despite its obvious qualities—face an uphill struggle competing with the Jetstream 41, Saab 340, Dash 8-300 and EMB-120 Brasilia, for a market segment (30-39 seats) that is no longer more promising than those for larger capacity aircraft (40-50 seats and 60 seats plus).

A Family of 328 Aircraft

Dornier's response to this new demand could take shape fairly quickly, in the form of a stretched version, known as the Dornier 328-S, capable of carrying 48 passengers. This new version would share many elements of its smaller brother, especially where the cockpit, engines and most of the systems are concerned. Two fuselage sections, 6.8 m long, would be added to the wing, giving a total length of 28.08 m; this would allow a configuration of 48 seats with 31 inch pitch. In addition, the undercarriage would be strengthened, as well as the wing box.

If this programme is launched according to plan, before the end of the year, there is a strong risk of a stiff competition developing between this aircraft and the new Saab 2000 commuter, which is faster still than the DO328, with a top speed of 365 kts (against 345 kts for the DO328). If the stretched German commuter aircraft is launched this year, it should enter service beginning 1996. Horizon Air has already indicated interest in this version.

According to Dornier, the main advantage of the 328S is the fact that it has much more in common with the 328 than the Saab 2000 has with its little brother, the 340B. The Swedish aircraft, for example, use different engines made by different companies. In this case, says Dornier, the commonality aspect will win over those airlines which might have been tempted by the higher speed on the Saab 2000 compared to the 328.

The A321: the German Airbus

In Hamburg, assembly of the first Airbus A321—which is often called the "German Airbus"—began last December. The Deutsche Airbus teams have already begun to assemble the main elements of the A321: the central wing sections, the undercarriage doors and fuselage panels. Beginning in June, the components built by other European Airbus Industries partners will begin to arrive in Hamburg, including the cockpit and forward fuselage delivered by Aerospatiale, the wings by British

Aerospace and the tail empennage by CASA. Final assembly will start on 15 June, the first day of the ILA airshow.

This programme is characterised, in comparison to the A320, by a few differences at the industrial participation level. British Aerospace is thus, for the first time, responsible for a fuselage section—that which is added to the rear of the central section on this lengthened version of the A320. Alenia, which is participating for the first time in an Airbus programme, is making the additional forward section. As for Deutsche Airbus, it is in charge of most of the fuselage, the vertical empennage, and the interior finishing of the cabin, as well as the final assembly.

Compared with the Airbus A320, the A321 is over 7 m longer (some 44.5 m longer in total), and can carry 186 passengers. This means that it offers a passenger-carrying capacity 24 percent higher than the A320, and has a 40 percent higher freight capacity. With a range of 4,500 km, the A321 has been designed for short/medium-haul routes with high-density traffic.

The first A321, to be fitted with IAE V2500 engines, should make its maiden flight in the spring of 1993. The first aircraft is destined for Lufthansa, which will take delivery of it in 1994, while the second, fitted with CFM56-B power plants, is for Alitalia.

From the A321 to the A319

By deciding to launch the A319's commercial campaign, the 130-seat short-haul aircraft based on the A320, Airbus Industrie's monitoring committee, which met in Frankfurt on 1 May last year, also decided in favour of German industry regarding the division of tasks. The new aircraft will now also be assembled on the Deutsche Airbus site in Hamburg. In compensation, the French have succeeded in being allowed to carry out the internal fitting of A320s in Toulouse rather than in Hamburg.

At this meeting, it was also agreed that from now on all the new short-haul aircraft in the Airbus range will be assembled in Germany. This would seem to point the way forward for the A320 to be assembled in Germany too.

Airbus is expecting to sell 450 A319s and some 250 additional A320/A321s, by emphasising the "family effect," in order to compete with Boeing's 737. A launch customer airline must now be found for the A319, as well as a sufficient number of orders to ensure the future profitability of this programme.

[Boxed item on p 31]

Dornier 328 Order Book:

1. Horizon Air (USA): 35
2. Sunshine Aviation (Switzerland): 1
3. Air Engiadina (Switzerland): 1
4. Afrimex Aviation (Nigeria): 1
5. Air Caledonie: 1
6. Bel Air (Nigeria): 2
7. Tahiti Conquest Airlines: 1
8. Cayenne Ltd. (GB): 1
9. Unannounced: 2

Total: 45 firm orders (plus 28 options) for nine customers (at 15 May 1992). [End of boxed item]

[Boxed item on p 33]

Airbus A321 Order Book: (at 31 March 1992)

1. Lufthansa (20)
2. Alitalia (40)
3. Euralair (2)
4. GPA (13)
5. Hapag Lloyd Flug (8)
6. Iberia (15)
7. Swissair (19)
8. Air Inter (7)
9. Ansett Australia (10)
10. Austrian Airlines (6)

Total A321: 140 aircraft on firm order, with 10 customers.

Total A320/A321: 794 aircraft, 36 customers. [End of boxed item]

Eurocopter

92WS0678G Brussels EUROPEAN AVIANEWS INTERNATIONAL in English Jun 92 pp 34-35

[Article by Alphonse Dumoulin: "A World Premier"]

[Text] Finally, after several years, the long-awaited merger of the helicopter divisions of Aerospatiale and MBB within the private company, Eurocopter, undoubtedly represents a global-scale event for the helicopter industry.

The realisation of this cross-border union took longer than expected, due to its particularly complex nature—from the financial and legal viewpoints, as well as psychologically...

It is worth emphasising that Eurocopter is the first true international merger in the aeronautical sector. It is more significant than joint ventures, GIEs (economic interest groups), associations and other cooperations—even transatlantic ones, to which large industrial companies have accustomed us.

Since January 16 therefore, the two former competing companies have been working together under the single banner of Eurocopter. This Franco-German marriage represents an extension of a cooperation begun several years ago with the bilateral Tiger attack helicopter programme.

A private holding company was formed by Aerospatiale and MBB (Deutsche Aerospace) in a ratio of 60:40. The difference in financial and industrial size between the partners was not the least of the problems in this complex merger. Yet, despite the disparities, the Germans still retain the power (to decide how the company should be managed) equal to that held by the French.

Eurocopter Holding SA is the umbrella company for the *societe anonyme,* Eurocopter S.A., which itself has a 100 percent stake in the capital of three national industrial subsidiaries—Eurocopter France and Eurocopter Deutschland (the former helicopter divisions), and a newly-created marketing organization—Eurocopter International. The latter integrates the sales and marketing teams of the former companies, and can now offer customers the largest existing range of helicopters: seven base models, available in 11 civil and military versions. These include a light single-engined aircraft of 2 tonnes up to a twin-engined helicopter weighing over 9 tonnes.

First Global Exporter

Now that its organisation is complete, Eurocopter is the world's second-largest helicopter manufacturer, behind the American Sikorsky. Furthermore, it is by far the largest global exporter, having delivered 10,000 helicopters to 123 countries.

In the long term, the new European group will take over all national and foreign companies and subsidiaries of which Aerospatiale and MBB were owners or co-owners. Thus, only shortly after the creation of Eurocopter International Belgium in March in Brussels, the Heli Expo 92 served as a framework for launching the American Eurocopter Corporation, born of the merger between the American branches of Aerospatiale and MBB. As to the former MBB plant in Fort Erie, Ontario, it has been renamed Eurocopter Canada Ltd.

In the United States, as in Europe, the setting up of the complete Eurocopter structure has therefore proceeded slowly in order to fit in with the various legal statutes ("anti-trust" laws). However, some important intermediate stages have already been carried out—particularly as part of the large Franco-German Tiger programme. Thus, in May 1991, the formation of Eurocopter International, and its first large-scale marketing operation was seen at the Paris Air Show last year, when the two manufacturers shared a common stand and all their helicopters carried the Eurocopter logo.

Another very significant step in their progressive fusion of facilities was carried out discreetly with the transfer of production of the AS350 Ecureuil from the plant in Marignane (where it was born) to the Donauworth production plant in Bavaria. This is where the French light helicopter is now made, alongside the German Bo 105 and BK 117. From now on, Eurocopter Deutschland will specialise in the manufacture of light aircraft (less than 3.5 tonnes), and Eurocopter France will be responsible for the range's medium and heavy rotorcraft range.

[Boxed item on p 35]

New Development of the BO 108 Programme

The light twin-engined BO 108 helicopter has been undergoing flight tests since its maiden flight in October 1988. Prototype No. 1 has currently logged over 200 flight hours, while the second prototype, flying since June 1991, has already clocked more than 60 hours.

Eurocopter says it is satisfied from a technical viewpoint with the flight tests on prototype No. 2, which have taken place since the end of 1991 with Turbomeca TM 319-1B Arrius turbo-engines. Last March, the helicopter was fitted with a rear rotor made of composites without joints, called "FVW." Beginning in June 1994, the BO 108 will be equipped with a main rotor with a 10.2 m diameter, increasing the aircraft's performance. New flight tests will be carried out to optimise the BO 108's rotors.

At the same time, market studies have been done, in order to integrate potential customers' requirements in the aircraft's final configuration, with regard to the cabin's capacity or technical aspects. [End of boxed item]

Growing Cooperation With CIS

92WS0678H Brussels EUROPEAN AVIANEWS INTERNATIONAL in English Jun 92 pp 36-39

[Article by Theo Pirard: "The Temptation of 'Drang Nach Osten' (Pushing East)"]

[Text] At a time when Europe is shaken by the repercussions of the breakup of the Soviet empire, and finds itself faced with tough technological challenges, its centre of gravity is drifting East. Germany in space is now tempted both by the great needs of this society which was previously under communist control and by the technological heritage left by the former Soviet industry.

Europe in space is now banking on increased cooperation with Russia (in particular), to move forward its plan for independence in the long term. Germany, which is geographically close to the ex-USSR's former satellite countries, is finding it easier to make contacts with the East, thanks to the integration of its own ex-DDR states.

In July 1989, Germany set up its own space agency (which is similar to France's CNES), DARA (*Deutsche Agentur fur Ramfahrt-Angelegenheiten*) in Bonn. After a rather painful birth period, DARA has also had to contend with a number of difficult problems in its early years. Indeed, there was already a well-organised body in

Western Germany, the DLR (*Deutsche Forschungsanstalt*), before this. DLR is the aerospace research establishment, modeled on NASA in the United States. DARA has a staff of 300 people hailing from scientific and industrial sectors, from the DLR and BMFT [Federal Ministry of Research and Technology]. The DLR employs 3,900, a quarter of whom are involved in space activities. The DLR has several centres spread across Germany in Braunschweig, Gottinger, Cologne (Porz-Wahn), Lampoldshausen, Stuttgart, Oberpfaffenhofen (Munich), Berlin and Weilheim.

The opening of the East has encouraged the development of DARA. This organisation has incorporated the former East German space research institutes. Last March, in cooperation with the DLR, DARA saw its first spectacular success with the Mir 92 mission and the German cosmonaut Dietrich-Klaus Flade on board the Mir orbital complex. It is also preparing the Spacelab D2 mission in March 1993, during which two German astronauts will board the space shuttle. So France is not the only country to have flown its researchers on board the Russian stations and American shuttle. Moreover, Germany ranks first, after the U.S. and USSR, with regard to the number of its citizens that have been into space: five Germans have participated in space missions and notched up a total of almost 49 days in orbit.

DARA, which is in charge of coordinating the activities of Germany in space, is confronted with two new facts: the temptation to do business with the East and the high cost of reunification. More than any other country in the European Community and the ESA [European Space Agency], reunified Germany feels concerned by the changes that have led to the break-up and crumbling of the Soviet empire. Germany has adopted a long-term strategy in which the influence of western mentality has always wanted to counter-balance the East's Islamic tendency. That is why the country is encouraging its manufacturers and investors to set up in the Commonwealth of Independent States (CIS)—especially in the Baltic republics, Russia (as far as Siberia) and the Ukraine.

The Bundespost also uses space technology, as does its commercial subsidiary, Telekom. Germany uses two German DFS-Kopernikus satellites, which were launched by Ariane. But the Bundespost—surprisingly enough and without taking into account the fact that Germany's aerospace industry is involved in the production in Europe of Ariane—has been attracted by the less costly solution of the American Delta II launcher, offered by McDonnell Douglas. The DFS-Kopernikus satellites are used to improve communications with the East. Another German preoccupation: the broadcasting of TV channels to Central Europe. The Bundespost prefers the PAL-Plus standard, rather than a MAC European standard (the D2-MAC, then the digital HD-MAC), because PAL-Plus can be picked up by current receivers. At a stroke, the German and French authorities have found it very difficult to launch themselves together into the coming pan-European Europesat system of satellites for direct broadcast. The only common area between Germany and France is on future television: images in the 16:9 format.

DASA or the First Giant Steps

The names of MBB, ERNO and Telefunken will soon be no more than memories, as they will be integrated into the Deutsche Aerospace group (DASA). Dornier and MTU will be able to exist as subsidiaries. As Dr. Hubert Hofmann, Vice-President Satellites and Applications Systems and Director Marketing Space, explained to us, the Space Systems Group represents one-tenth of DASA's activities, employs 4,500 people and has a turnover of DM1.5 billion (ECU729 million) per year. "The space sector of Deutsche Aerospace represents 70 percent of space activity in Germany. We have centres of excellence for specific activities: at Dornier in Friedrichshafen for satellites and systems applications; at MBB in Ottobrunn for space transport and propulsion systems; and at ERNO in Bremen for orbital infrastructure. The Satellites & Applications Systems Division is following a production strategy in four sectors: space science, earth observation, telecommunications satellites and microgravity experiments."

In the space field, Deutsche Aerospace is a shareholder of Arianespace and Euro-Hermespace, and is preparing for the creation of Euro-Columbus. At present, DASA is a partner in the three "A"s—Aerospatiale, Alcatel and Alenia—which are already associated with Space Systems Loral. On this, Dr. Hofmann had this to say: "We are in the process of evaluating whether we can take a participation, alongside our European partners, in Space Systems Loral. The Satellites & Applications Systems Division is positive about this initiative and we hope to make an announcement on our decision during ILA 92. In this case, Deutsche Aerospace would take a 12 percent holding of a European "DSA" group in Space System Loral's capital. We are already participating in the calls for bids with Aerospatiale, Alcatel Espace and Alenia."

In the telecommunications satellites sector, DASA is turning towards new markets with original ideas. Rolf Arnim, formerly head of the company Eurosatellite for the marketing of direct television broadcasting, is in charge of DASA's communications programmes. The most recent project is called Romantis, about which Dr. Hofmann says: "Romantis is not yet at the system stage, but only a concept for an international telecommunications system in cooperation with Russia, Ukraine, Kazakhstan and Belarus." A German consortium has been specially formed to realise this project: this includes Deutsche Aerospace, ANT Bosch Telecom (which had the idea for the project) and the Deutsche Bundespost with Telekom. Germany is showing strong interest in setting up the Romantis system, which will be a superb tool for facilitating economic relations between the East and West. From a technical viewpoint in particular, the project is made possible by using three geostationary

satellites to cover the whole of the CIS. "Economically-speaking, we are currently assessing its management risks and the problems involved in realising it."

For Romantis, if everything goes smoothly, Deutsche Aerospace will no doubt be obliged to get involved financially in operating the system. "We will have to move from the role of constructor and assume that of an operator. This is what happened in the U.S. with Hughes and GE. In the future, countries will hand over to commercial operators the use of their domestic telecommunications satellite services, as in Argentina and South Africa. DASA is studying a proposal for the Argentinian Nahuel system, but faces serious competition from Intelsat and Hughes." As far as mobile communications systems are concerned, using low orbit satellites, Deutsche Aerospace is presently open to Iridium (with Lockheed), Odyssey (with TRW) and so on. But if the German group wants to become an associate of Space Systems Loral, it will have to support its Globalstar project.

Environment and Disarmament

The backbone of Deutsche Aerospace's space activities is at Dornier in Friedrichshafen. It concerns activities linked to earth observation with in-orbit systems. It has achieved a success with ERS-1—the European microwave remote-sensing satellite, which was launched on July 17, 1991, and which is producing spectacular results with all-weather images using its SAR [Synthetic Aperture Radar].

ISO

At Dornier, a cryogenic test bench for the Isophot experiment, which will be carried on-board the European ISO satellite. (Photo: Dornier [photo not reproduced].)

Dornier is now working on ERS-2, an exact copy of ERS-1 but also equipped with the GOME [Global Ozone Monitoring Experiment] instrument and the X-SAR made by Alenia Spazio. ERS-2 can be launched from 1994, and the X-SAR will be tested in 1993 aboard the shuttle with NASA's Space Radar Laboratory. This makes Deutsche Aerospace the European leader in microwave remote sensing.

According to Alfred Setzer, director of Earth Observation Programmes, DASA can offer a whole range of sensors for environment surveillance and disarmament control. The optical sensors are particularly a speciality of MBB and Jena Optronik GmbH, which is a new subsidiary created from the eastern German company Carl Zeiss Jena. The MOMS [Modular Opto-Electronics Multispectral Stereo-Scanner] will fly on the Spacelab D2 mission, and there are plans for it to be installed on the Preiroda module of the Mir station. Deutsche Aerospace is therefore well placed for the important global observation by satellite projects for ecological, economic and strategic ends. Among these projects is the POEM-1 [Polar Orbiting Earth Mission] payload, for the ESA's Columbus Polar Platform and for the satellite the WEU [Western European Union] plans to acquire for military environment surveillance.

Dornier is the prime contractor for the POEM-1 payload, which will include sensors from the EAS and Eurnetsat. This craft, weighing over 2 tonnes, is the logical follow-on to the ERS programme for the end of this decade. It should be integrated by British Aerospace onto a bus derived from the SPOT 4 platform by Matra Marconi Space. Germany had prepared the ATMOS satellite project for studying the atmosphere, but this project has now been halted, because of federal budgetary restrictions for space. Dr. Setzer says: "This programme is still in existence, although no longer as a completely separate satellite, but rather as a reserve for remote sensing atmosphere instruments that are proposed for installation on POEM-1." Furthermore, the WEU has selected Dornier to lead a European consortium of about 30 companies as part of an 18-month study into all the space observation systems that are available or in preparation in Europe.

Small Satellites

During the Mir 92 mission, in which a German astronaut-researcher took part, two small companies, namely Kayser-Threde and OHB-System, played a vital role in supplying the equipment for the experiments. They have modern facilities with test means, integration rooms, computer systems and so on, and are determined to show their technological know-how in new and promising markets. These include collaboration with Russian industries, prime contractorship of small satellites, and the design and realisation of opto-electronic equipment.

In Munich, the Kayser-Threde company specialises in precision technology, especially in the space sector. Gunter Schmitt, manager of autonomous payloads, points out the possibilities for cooperation with Russian companies in microgravity and technological development activities. Kayser-Threde, which employs some 170 people at two Munich facilities, and which has an office in Moscow (Centre SPLAV), now wants to benefit from several years' experience with Russian space equipment for experiments by the company Intospace in Hannover. An integration hall contains a recoverable capsule, derived from that used for the first Soviet space flights in the sixties. This type of capsule, called Foton/Bion, is currently produced by the Russian company, KB Foton of Samara and is used for experiments in space lasting two to four weeks.

The most ambitious project concerns the commercialisation of the Eurokosmos capsule, which is an upgraded version of the Foton, Bion and Resours. Says G. Schmitt: "With the Eurokosmos system, we are offering a capsule that can be re-used three times, and which is specially fitted to better meet the needs of western scientists. We are in the process of improving the attitude control, communications capabilities, access for life sciences experiments, and the possibilities for remote science

operations (experiments in space controlled remotely from earth laboratories)." Kayser-Threde has signed a pre-agreement with KB Foton covering five missions, beginning in 1994. "By offering a complete service to the Russians, from preparations in Plesetsk to landing in Kazakhstan, our goal is to supply experiment equipment to the laboratories, such as ovens, incubators, etc., to fly on Eurokosmos. We have been collaborating for several years with the SPLAV centre in Moscow."

Moreover, Kayser-Threde is working on other capsule projects, like Mirka, which is a technological mini-capsule for re-entry tests and equipment tests. Another project is the Express capsule, to be satellised by the Japanese Institute of Space and Astronautical Science's M-3S-II launcher. For this, Kayser-Threde is offering an economic capsule produced by Russian expertise. The Munich company is present in payloads for Spacelab (instruments for the D2 mission) and on Astro-SPAS (with the ORFEUS ultraviolet telescope, which is produced for the Max Planck Institute and costs some US$10 million (or ECU7.9 million)).

For the marketing of space applications, Kayser-Threde is interested in space navigation systems, a part of the European Navsat programme, either with the American GPS or with the Russian Glonass. It is the first European company to study the Glonass receivers to make them compatible with the two systems, and then to market them. Niko Balteas, Program Manager Satellites, Communications & Navigation Systems, showed us the Tubsat-B micro-satellite, to be launched with the Meteor 3 satellite in August 1993. Built by the Technical University of Berlin, this Tubsat-B is adapted by Kayser-Threde to test the Polarcom system. Balteas describes Polarcom as "a good value network of six microsats at 1,200 km altitude, which will allow real time links to be established between the bases spread over the Antarctic for up to three hours a day."

"We are also working on the Temisat project, which consists of a data-collecting small satellite above the Mediterranean. And we are offering 25 kg satellites in low orbit for a global professional telecommunications service."

OHB-System

Based in the north of Germany, not far from the University of Bremen's microgravity tower, OHB-System has offices, laboratories and integration rooms. The company is managed by a former ERNO employee, Manfred Fuchs, and this SME demonstrates a great deal of originality in developing new systems for activities in space. The company offers researchers the Mikroba rocket system, which is towed by a stratospheric balloon to an altitude of 40 km, before creating microgravity for one minute as it falls back to earth. Mikroba is produced and operated by OHB-System, and can be used to carry payloads of 200 kg in models that are recoverable and which can be flown on-board TEXUS and MAXUS rocket-probes.

OHB also supplies the instruments for the manned Mir 92 and Spacelab D2 missions. Its goal is to design cost-effective systems that can be used to prepare more complex equipment and to make space more accessible. The company therefore makes small satellites like the Bremsat for the University of Bremen and the SAFIR [Satellite for Information Relay]. Weighing just 68 kg, the Bremsat will be placed into orbit by the shuttle during the Spacelab D2 flight; it will be used for studying the space environment, especially during the re-entry into the atmosphere phase. SAFIR (55 kg) will be launched to 700 km at the same time as a Russian Resours satellite in the spring of 1993. This satellite will then communicate with automatic stations, or macro-stations, to gather data on the environment.

OHB-System is particularly concerned with producing sensors to study the atmosphere and has carried out a special study of instruments for the German Atmos satellite project. It cooperates with the Russian remote sensing association, Sovzond, to facilitate (with the Resours and Meteor satellites) the development of instruments for POEM-1, the first payload for the Columbus polar platform. In the field of recoverable capsules for experiments in microgravity, OHB is working on two systems: Express with Westinghouse, as part of a cooperation between Germany and Japan, and the Taurus, to quickly return results obtained on manned modules.

Clearly, Kayser-Threde and OHB-System do not lack ideas when it comes to advertising their presence alongside the big German companies.

Defense Programs

92WS0678I Brussels EUROPEAN AVIANEWS INTERNATIONAL in English Jun 92 pp 40-41

[Text] While controversy continues to rage in Germany about the "Jaeger 90" (EFA) programme, other cooperation defence programmes (especially with France) are also coming up against financial barriers.

The EFA programme is undoubtedly the most controversial. This cooperation programme, which brings together four countries (Germany, Great Britain, Italy and Spain), has now reached a crucial stage in its development, having begun back in 1988.

The first two EFA prototypes—DA1 in Ottobrunn, Germany and DA2 in Warton, England—are at an advanced stage of assembly and the main systems are undergoing tests. The two other prototypes, which will be used for static tests in Spain and Germany, are also being assembled. After the systems and engines are tested, the first flight of the DA1 prototype (assembled by MBB) should take place this autumn. The delay incurred in the initial timetable means that the Eurofighter will not now be able to attend the Berlin show, nor that in Farnborough in September. A decision regarding the production phase for the EFA programme is expected at the beginning of 1993.

In Germany, the questions being asked about the costs of the EFA programme have led to repeated criticisms. According to the latest estimates, the unit cost per EFA could stand at between DM105 million and DM135 million (ECU51-66 million). Germany, which decided to pull out of the development of the electronic warfare system (like Spain) and is not participating in the development of the EFA's weapons system, is asking manufacturers involved to make another effort to reduce the programme's costs. And this after the same manufacturers have already suffered losses due to development contracts made on the basis of fixed prices.

According to experts, the EFA is still the only aircraft that meets the Luftwaffe's future needs. It appears that nobody is able to come up with a viable alternative. To date, a number of different options have been examined: either buy an existing American-made aircraft (F-15, F-16, F-18) or even a Soviet one (Germany already has some MiG 29s), or opt for an upgraded Tornado, or choose one of the other fighter aircraft now under development, like the Rafale, Gripen or F-22. However, all these solutions have been dismissed by the German staff, either because they do not meet its operational needs, or because they would be too expensive—especially in the case of the F-22.

A parliamentary committee has studied this programme from a number of viewpoints—military, industrial, technological, political and economic—and has to make its report shortly. This should help to clarify the debate and to get a political agreement at the beginning of the summer regarding the participation (or not) of German industry in the production phase. If the answer is eventually positive, the number of aircraft for the Luftwaffe could still be reduced: probably 150 aircraft, instead of the 250 initially foreseen.

Whatever the decision, it will have a profound effect on Germany's future and its industry, for which the EFA represents the only possibility of maintaining its technological level and of keeping its ability to participate in future international programmes. From an economic standpoint, if the EFA is chosen, economic estimates already point out that Germany will recover 40 to 60 percent of sums invested in the form of taxes and duties.

Helicopters: Between the Tiger and NH90

Although the development of the Franco-German combat helicopter programme, which has been underway since 1988, looks to be assured without any hindrances, the production phase is raising questions. Its Fr9 billion (ECU1.3 billion) development cost is guaranteed 100 percent, but the green light for the industrialisation phase is expected at the beginning of 1993. Production could be put back, and the Tiger would not be available before 1999, instead of 1997 in its fire-support version and in 1998 in its anti-tank version. The number of helicopters produced in the end could also be modified. Although the French and German markets should normally account for 427 helicopters, Germany could reduce its orders to 138 aircraft, instead of the 212 originally planned. France plans to acquire 215 Tigers, with 75 armed scout versions and 140 in the anti-tank version. In addition to these two markets, Great Britain and the Netherlands represent good export opportunities for Eurocopter.

Within a longer timeframe, the NH90 programme should go even further towards strengthening Franco-German cooperation in defence. Eurocopter has a majority participation (66.4 percent) in this four-nations programme, which also includes Italian and Dutch partners.

Definition of the NH90 has now been completed and the development phase should be launched this year; this new phase should last until 1998 and cost some ECU1.37 billion. Eurocopter is expecting a potential market of 726 aircraft (not including exports).

Euromissile: 20 Years

With the launch of the new supersonic anti-vessel, ANS, MBB is celebrating 20 years of cooperation with Aerospatiale, as part of the GIE [economic interest group] Euromissile. This 50/50 joint venture between the French and German companies, which was created in 1972, has given birth to a family of medium- and long-range anti-tank missiles, known as Milan and Hot, as well as to the Roland, a short-range surface-to-air missile.

In the anti-tank sector, Euromissile is continuing with the upgrading of Milan and Hot, while EMDG (Euromissile plus BAe) is continuing with the development of the new generation of Trigat MP and LP. The Roland is also the focus of a complete upgrading programme, which concerns its firing system (BKS), its optics system (Glaive) and its missile (VT1).

In the field of anti-vessel missiles, the development of the ANS [Anti-Navire Supersonique] was approved by the German and French governments (the latter has, however, only given conditional agreement). The first production ANS missiles should be delivered in 1999. Intended as replacements for the Exocets, the ANS will offer unparalleled performance: 200 km range at Mach 2+.

Again within the Franco-German context, but this time as part of Eurodrone, Matra is developing the Brevel reconnaissance system in cooperation with MSG, a subsidiary of Bremer Vulkan. Yet this drone programme could also be cut for budgetary reasons (the new military planning law in preparation in France is likely to err on the side of austerity), as well as for operational ones: Is this drone now such a priority for French and German forces, which already have the Canadian CL-289 system?

The total cost of developing two systems is so high (Fr4 billion, or ECU580 million, according to French estimates) that it is unlikely two programmes will be launched, and a choice will have to be made between the ANS and Brevel.

Where guided missiles are concerned, other cooperation possibilities are under study in Germany, especially concerning an ATBM system—for which a choice will have to be made between the American Corpsam and the European Eurosam—and a system of cruise stand-off missiles of the CWS [Cruise Weapon System]-type, for which the Apache made by Matra/Aerospatiale is being considered.

Radars: TST/Thomson-CSF Alliance

Last February, a new Franco-German alliance was born, between Telefunken System-Technik/TST in the DASA group and the RCM division of the Thomson-CSF group, for airborne radars for maritime surveillance missions.

This technical-commercial cooperation agreement is aimed at developing new, more sophisticated versions of Thomson-CSF's Ocean Master radar. This already incorporates leading-edge techniques and technology, like digital processing of signals and data, track-while-scan, variable antenna rotation speed, built-in test equipment (BITE) and so on. The other developments will essentially concern the high gain antennas, the high power transient wave tubes, and the upgrading of the ISAR [Inverse Synthetic Aperture Radar], allowing the generation of vessel silhouettes and thus the improvement of target classification capabilities.

TST and Thomson-CSF will offer the Ocean Master radar family for new programmes like the European NH90 helicopter or the German MPA 90 maritime patrol. The Southeast Asian markets are also being targeted; a CN-235 demonstrator by the Indonesian constructor IPTN, which has been equipped with this radar, was recently present at the Singapore Air Show.

BMW/Rolls Royce Partnership

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[Article by Doug Birch: "The Emergence of a Challenger"]

[Text] The Anglo-German partnership of BMW Rolls-Royce GmbH was created just two years ago in July 1990, as a joint venture agreement between German automobile engineers, BMW AG (50.5 percent), and Europe's largest aircraft engine manufacturer, Rolls-Royce plc (49.5 percent). The specific aim of the partnership is to design and develop a new family of turbofan propulsion systems encompassing a thrust range of 12,000 lb to 20,000 lb.

Management experience and quality products are synonymous with BMW and Rolls-Royce, with the benefits of technical systems expertise (BMW) and state-of-the-art engine technology (Rolls-Royce) providing a firm work foundation.

Shared activity and technology transfer is already apparent in areas such as material technology research—including resistance to extremes of temperature, protective coats and component operating life. The companies have also adopted shared systems and procedures in development work—CAD systems and extensive computer programs for three-dimensional flow analysis, plus the design and manufacturing processes for highly stressed components and compliance with increasingly severe consumption and emission regulations.

The BR700 series features an engine design based primarily on Rolls-Royce's experience in wide-chord fan applications, as well as the British company's intimate knowledge of the problems of foreign object damage (FOD), engine quietness and the engine's 5 million hours in-fleet service record. Further pedigree derived from the Tay booster's reliability and surge-free I.P. compressor is incorporated into the new engine and, most crucially, core technology based on Rolls-Royce state-of-the-art affordable engineering. Other proven technology used including Trent low-pressure turbine expertise with 3D aerodynamics and FADEC, based on Rolls-Royce's EC experience.

The engines derive from a common core consisting of high-pressure compressor, combustion chamber and high pressure turbine. Three low-pressure spool designs allow variants to be optimised to suit different customer requirements, thereby reducing cost and risk.

The BR700 Family

The core launch took place in 1991, and the first core run is scheduled for 1993; engine entry into service is expected in 1996. Three variants are currently planned; the BR710, with a thrust envelope from 12,000 lb to 15,000 lb. The BR715, 14,000 lb to 22,000 lb, and the BR720 generating over 22,000 lb.

Applications for the BR700 family cover the spectrum from business jets, at the lower end of the thrust scale, through 60- to 79-seat regional airliners, increasing to 80- to 119-seat regional jetliners and larger military transports uplifting payloads of between 6 and 30 tonnes, to the higher thrust requirements of the 120- to 140-seat airliner.

Market forecasts for the BR700 series engines between 1996 and 2010 point (perhaps now rather optimistically) to potential sales of 3,000 units, or one-third of projected market demand.

Engineering for the BR700 is being carried out at Dahlewitz in Mark Brandenburg, just south of Berlin, with the former KHD Luftfahrttechnik GmbH, Oberursel, just north of Frankfurt; the latter houses the company headquarters, and small engine activities—including development, manufacture and product support.

Revenue-sharing partnerships make up 20 percent of the Rolls-Royce Tay programme and parts manufacturing, 5 percent of the Rolls-Royce Trent programme, including engine testing and a 5 percent share in the SNECMA contribution to the CFM 56-6 project, incorporating the manufacture of parts.

The takeover of KHD Luftfahrttechnik GmbH led to all its activities and commitments passing to BMW Rolls-Royce GmbH. Accordingly, small gas turbines with thrusts of up to 5,000 lb are still being developed at Oberursel. These comprise the T117 turbojet, now installed in the CL289 reconnaissance drone, a co-manufactured product by Canadair and Dornier.

This engine is fitted with a pneumatic starting system, electrical generator, high-energy ignition, hydro-mechanical fuel control unit, and it is of single-shaft design with centrifugal compressor, reverse flows annular combustion chamber, one-stage axial turbine, self-supporting oil system and accessory drive gearbox.

The T312 turbo-shaft engine of similar design to the T117, is installed in the multi-role Tornado aircraft, serving as an auxiliary power unit (APU). It represents an essential component of the secondary power system (SPS) and mainly accomplishes the following functions in connection with the accessory drive gearboxes: starting of main engines, electrical and hydraulic power supply without main engines running, and the delivery of bleed air.

A third engine, the T118, has successfully demonstrated the capabilities of a pneumatic bleed type APU in the 200-250 kw equivalent power class.

Repair and overhaul services play an important role and include Rolls-Royce Gnome turbo-shaft engines, Lycoming T53 series and GRTS Larzac 04C6 and 04C20 power plants. However, all these activities are now subsidiary to the BR700 engine, which is seen by the company as the lead power plant for many business jets and regional airliners. There are also plans to have a re-engining role for existing aircraft. Technical advances are expected to reduce direct operating costs (DOC) and fuel burn by 15 percent.

Company Structure

BMW Rolls-Royce has a capital in excess of DM200 million (ECU100 million), and during the remainder of the decade will make investments of just under DM1 billion (ECU500 million). Some DM400 million (ECU200 million) has been allocated for the BR700 conservatively estimated to involve around DM0.9 billion (ECU450 million).

Rolls-Royce, with its global network of 70 repair bases and 320 representatives, is undertaking marketing and product support of the new engine family.

At the end of 1991, the company employed over 1,000 staff, but as the development programme expands, further personnel—especially engineers—will be required. Add to this other skilled staff needed for engine assembly, and the expected work force will reach 2,000 by the end of the century.

Albert Schneider, chairman, had this to say at the Paris Air Show in June 1991: "We believe the overall worldwide demand for aircraft engines will amount to some 3,000 units annually for the next five years. BMW Rolls-Royce therefore has excellent prospects and expects to achieve a turnover in the region of DM1 billion by the end of the decade."

The current market leader in the BR700 thrust class is the best-selling Rolls-Royce Tay, lead power for the Fokker 100 and Gulfstream IV. But Schneider bases his company's forecast on the introduction of new, large business jets from Canadair and Gulfstream, and the building of planned regional jets by Canadair, Fokker, British Aerospace, Airbus and Tupolev.

This market will not be easy to "break into." Most of the planned aircraft are derivatives, i.e., the Fokker 70—a version of the Fokker 100, the RJ70, a variant of the BAe 146 and the Airbus A319, a shortened version of the A320.

Despite its undoubted pedigree, the BR700 will be competing for a market already made successful by the high-quality engines currently in use and airlines that are notoriously conservative when it comes to interrupting a profitable formula of engine and airframe. The BR700 will be attempting to prise its way into a satisfied market at a very difficult time, and to succeed, it will have to offer clients something very special indeed.

[Boxed item on p 43]

Summary of BMW/Rolls Activities:

BR700 Family of Turbofan Engines:

—BR710 (10,000-15,000 lb);

—BR715 (14,000-20,000 lb);

—BR720 (20,000+ lb).

Revenue Sharing Partnerships:

—RR Tay turbofan (10,000-16,000 lb);

—RR Trent turbofan (64,000-95,000 lb);

Small Engines;

—T117 turbojet (240 lb);

—T118 APU demonstrator (200 kW);

—T312, T312-4 APU (114/136 kW).

Repair and Overhaul Service:

—GRTS Larzac 04C6/04C20 (3,150 lb);

—Lycoming T53 series (1,100 kW);

—RR Gnome turboshaft engine (700 kW). [end of boxed item]

MTU's Engine Projects

92WS0678K Brussels EUROPEAN AVIANEWS INTERNATIONAL in English Jun 92 p 44

[Text] MTU (Motoren-und Turbinen Union) has had experience of many cooperation programmes, and has developed an expertise which it certainly intends to develop, by becoming prime contractor for a civil engine programme.

Negotiations are still underway for an exchange of reciprocal holdings between MTU and Pratt & Whitney, which are considered to be each other's "preferred partner." This is part of an extension of the cooperation agreement between the two engine-manufacturers. An agreement should be concluded before the year's end or by the beginning of 1993. An evaluation of the two entities' respective weight is currently underway, as MTU is to change its legal status to become an "AG," while on the American side, Pratt & Whitney (the division of the American United Technologies group, or UTC) is to become a subsidiary.

Even before the conclusion of this accord, which represents a logical follow-on to a cooperation that has already been in existence for 60 years and the alliance agreed by their parent companies, MTU and PW have begun to exchange engineers and data. The goal is to achieve greater competitiveness, by rationalising the activities of the two companies.

The first new programme on which the American and German teams are currently working is known as RTF 180. This is for a family of small turbofans of between 13,000 and 23,500 lb thrust; their launch is principally linked to the Regioliner programme.

MTU's aim is to win the prime contractorship of this programme, whereas usually, this German engine-maker's participation is around 12 percent of international civil programmes (apart from the PW300, where MTU has a 25 percent interest).

Cooperation in All Areas

In the field of civil aeronautics, MTU is participating in the following cooperation programmes (MTU's holding is between brackets), for which the company generally supplies low pressure turbines: IAE V2500 (11 percent); PW4084 (12.5 percent); PW2000 (21 percent); PW300 (25 percent) and GE CF6 (between 8 and 12 percent, according to the versions). Also noteworthy is the fact that the IAE consortium is currently studying an improved 35,000 lb version for 80-90 tonne aircraft.

In the military sector, its activities mainly concern:

—maintenance and support for numerous programmes, the most important of which is undoubtedly the RB199. This engine recently logged over 2 million hours on the Tornado, and has been in service for 13 years. More than 2,400 RB199s have been produced by the Turbo-Union consortium (Rolls-Royce, MTU and Fiat Avio) to equip the 900 or so Tornados that exist in different versions (IDS, ADV and ECR);

—the future EJ200 (Eurojet), intended for the European EFA combat fighter, represents the main and only development activity on the military side. Although the two first prototypes will be fitted with the RB199 (version Mk104E), the EJ200 should fly on the third aircraft in 1993. Current plans still call for 1,600 units of this 90 kN-class engine to be built. MTU's holding stands at 33 percent of the development and 30 percent of production, with Rolls-Royce, Fiat Avio and ITP.

Lastly, for helicopters, besides the co-productions with Allison (250-C20) and General Electric (T64), MTU is participating in two new European engine programmes: the MTR390 (40 percent) and RTM322 (15 percent). For the former, MTU is working on a turbo-engine in the 900 to 1300 kW thrust range, developed jointly with Turbomeca and Rolls-Royce, with 1,000 units to be produced for the Tiger helicopter. For the latter, MTU worked alongside Turbomeca, Rolls-Royce and Piaggio during 1991. This 1550-2240 kW thrust engine programme is principally aimed at the EH101 and NH90 helicopters.

CRISP: Economy and Ecology

One particular project seems to be cherished by MTU's management: CRISP, or Counter-Rotating Integrated Shrouded Propfan. MTU and the Federal Research Ministry (BMFT) have invested over DM100 million (ECU48.6 million) since 1985 in this programme. This "prototyping strategy" programme is intended to demonstrate the feasibility of an engine that, in comparison with traditional turbofan jet engines, is characterised by a higher bypass ratio, which increases its propulsion and saves up to 25 percent fuel. According to MTU, in combination with a combustion chamber with a low emission level of NOX, this "propfan"-type engine represents the precursor of a new generation of economic and ecologically-sound power plants. Tests were carried out with a 40 cm model, in the German-Dutch (DNW) windtunnel last December. Other windtunnel tests will take place during 1992 on a CRISP model, this time measuring 1 m. At the same time, MTU will also have a test bench working with an ADP [Advanced Ducted Prop] demonstrator, which has been produced with PW and Fiat Avio, and which will be based on the central core of a PW2000.

Having anticipated a gap between the RB199 and EJ200 programmes as far back as the seventies, MTU is less exposed than other companies to a fall in military orders.

Soon, the share of military orders will no longer represent more than 25 percent of the German company's activities.

AUTOMOTIVE INDUSTRY

France: Active Noise Control Systems Under Development

92BR0545 Paris ELECTRONIQUE INTERNATIONAL HEBDO in French 4 Jun 92 p 25

[Article by Pierrick Arlot: "Market of Silencers Begins To Make Noise"]

[Excerpts] Electronics is entering the area of undesirable noise control. The principle is to generate "antinoise waves" with opposite phases to those of the noises to be eliminated. In France, Mors is on track.

Will the quest for silence be at the origin of a new market? In fields as diverse as manufacturing, automobiles, or household appliances, undesirable noises in fact invade the sound space. The hunt is on. One of the first commercial outlets in France was noise suppression in ventilation shafts of submarines to prevent their detection. This technology was developed by the Mors group in close collaboration with ANVT, a U.S. company located in the UK, whose expanded company name perfectly reflects its activity: Active Noise and Vibration Technologies.

Two Different Technologies

In fact, the size of the potential market is such that start-ups have been created especially to benefit from the emerging fad for "active noise control," another name for the technology of suppressing noxious or disagreeable noises. Active noise control involves two different technologies. The first acts directly on the sound source by direct application of a "vibration muffler" operating at the same frequency but with opposite phase. The result is suppression of vibration at the source of the noise. The other technology acts on the sound wave itself and requires more sophisticated electronics. The frequency and phase of the wave are measured by a microphone; subsequently, another sound wave with the same frequency but the opposite phase is generated through a loudspeaker. As a result, the two waves cancel one another out—in theory. Although the principle of active noise control is simple, "its implementation is far more complicated," says Jacky Lecuivre, commercial director of the Major Industries and Defense department of Mors group. "For this reason, we decided to cooperate with a company that specializes in noise control, like ANVT," he adds. Goal of the cooperation between the two companies: The DCN [Naval Constructions Directorate] of Cherbourg decided to limit sound pollution in future generations of submarines by installing active noise control systems in the ventilation shafts. Mors was selected; the first products should be delivered by the end of this year.

Household appliances and automobiles will in fact be the two consumer sectors in which active noise control systems should be tremendously successful once they become affordable. The automobile manufacturer Nissan has been dealing with the problem for a long time; the Japanese company announced a few months ago that it had developed a system called Active Noise Control. Loudspeakers placed under the car seats emit sound waves to neutralize the waves emitted by the engine. The system, on which Nissan is said to have taken some 100 patents, could even automatically adjust to the various engine speeds.

The French manufacturers are not staying behind. PSA is conducting advanced research in this area and has called on Mors, the French manufacturer who is definitely making inroads in the noise control market. Mors has developed Sesame, a system with four pick-up and measuring paths that can be mounted on board of a car.

Each Mechanical Part in a Car Generates Noise

Sesame is dedicated to the acoustical and vibrational analysis of sources of noise, which could be any mechanical part of the car. Research into Sesame was cofinanced by Citroen and the ANVAR [National Agency for the Implementation of Research], while its implementation was entrusted to Techniphone Developpement, a Mors subsidiary dedicated to the contract development of new products.,

The system consists of a terminal and a pickup and processing computer (CAT), for which Mors has developed five specific boards: a clock board which generates the sampling frequencies, which may depend on the frequency of the phenomenon causing the noise to be measured (car speed, engine RPM, etc.); and four conditioning, digitizing, and processing boards that receive the signals from the microphones, speedometers, or tachometers. Each board is linked to a Motorola DSP [digital signal processor]. Although the system has been designed for an automobile application—PSA expects to acquire six to seven Sesame systems by the end of the year—Mors believes that its product should find outlets in other industrial sectors and join the vibration analysis systems of the leaders in the field, Hewlett-Packard and the Danish company Bruel & Kjaer.

France's PSA Adopts Japanese R&D Method

92WS0704B Paris L'USINE NOUVELLE in French 2 Jul 92 pp 24, 25

[Article by Alain-Gabriel Verdevoye: "Future High-End Vehicles Designed in a Revolutionary Manner; Peugeot Hurries to 'Go Japanese'"—first paragraph is L'USINE NOUVELLE introduction]

[Text] The automobile manufacturer wants to reduce its vehicles' design times. It will multiply preliminary studies in order to avoid cost overruns for the new models.

Time is money. It took some time for European car manufacturers, especially French ones, to accept that. But now, they are trying to shorten lead times right and left. And they do so with a vengeance. That is because reducing vehicle design time is a key factor in the struggle to achieve lower production costs; what is at stake is quite simply the survival of the automobile industry in Europe.

However, designing and developing cars the Japanese way, in four or even three years, is a tough challenge, one that implies a complete change in the way things are done. In fact, even the most recent French-made models (Citroen ZX, Renault Safrane) were still designed in five years. A fortiori the Peugeot 405 introduced in 1987, a redesigned version of which is about to be introduced. What the Peugeot group is now doing, therefore, amounts to a cultural revolution. The first results of this methodological overhaul will be the successors of the compact Citroen AX and the Peugeot 405, to be introduced in 1994. And especially the future high-end models that will replace the Citroen XM and the Peugeot 605 by 1998.

The Japanese way to reduce lead times is well-known. Right from the start of a project, the design and engineering department staff, the industrial engineering management, the manufacturers of production equipment, and the principal subcontractors must be made to work together. The goal is to have the design and industrialization stages overlap as much as possible. But that is not enough. To really design a car in four years, an entire preliminary study stage must be set up upstream. The way Toyota, Nissan, Mazda, and others do it.

"Clear the Ground" First

Peugeot just took the decisive step. Last January, it set up design teams of about 15 people each to "clear the ground" for three years, prior to the official start of a new project. The goal is to postpone the official start of new projects, and therefore make funds available as late as possible. And to do so based on a solid technical and financial dossier supported by preliminary research. From now on, Peugeot wants to avoid giving the green light too early to chancy projects whose technical solutions have not been validated, and which therefore may entail unforeseeable cost overruns.

At the Peugeot design center in La Garenne (Hauts-de-Seine), people still remember the mistakes made in designing the Peugeot 605 and XM, introduced in 1989. "The 605 kept getting heavier as it was being designed; it ended up weighing 200 kg more than expected. Meanwhile, the engineers designed a turbo-diesel engine that was less powerful than expected. For the 605 and the XM, we initially expected to invest 7 billion French francs [Fr], and they cost twice as much," a La Garenne executive recalled. This is precisely the type of costly mistake, in terms of time and money, that Peugeot wants to avoid. That is not easy.

The successor of the Peugeot 405, the design of which started officially last year, is already undergoing unfavorable weight and cost changes. And the development of the model that will replace the small Citroen AX appears to be difficult, even erratic. It is true that, initially, Peugeot had a very innovative product in mind. Under pressure from the group's financial department, the project became more tame.

With the institution of a preliminary design stage, Peugeot hopes to achieve tighter control over cost overruns for the projects whose development is about to start. These include the forthcoming high-end vehicles as well as the projected car that would replace both the Peugeot 205 and the Citroen ZX by 1999... and the Peugeot 306 as well. The latter has not been introduced yet, but its successor is already very much on the minds of the people at La Garenne!

"In Vivo" Tests

The design teams in charge of preliminary studies, headed by the project leader, include marketing, purchasing, procedures, and quality-control specialists. Their mission is to consider various vehicle construction (front-wheel drive, integral transmission, etc.) or body-type projects. It also includes testing new technical solutions "in vivo."

All these tentative designs will converge into a single project six months before Peugeot top executives give the green light. The task of these teams ends with the writing of a thick definition file that details the project, component by component, defines the factory assembly time of the future vehicle, and assesses the investments required.

The project is then taken over by the project management, which will oversee it during the four years of its official development. This flexible structure consists of 13 or 14 assembly-equipment managers, specialized according to the vehicle's major functions (opening assemblies, electric equipment, dashboard, etc). Renault uses similar methods for its mini-vehicle, which it will introduce next fall.

The advantage of these preliminary studies for Peugeot is that they make it much easier to design a series of variants of a single vehicle, and therefore take on fashionable niche vehicles (coupe, convertibles, recreational vehicles). Peugeot's future prestige vehicle should thus be offered, at least, as a four-door sedan and as a coupe. On the other hand, it is not certain that this model will be introduced under both labels, Citroen and Peugeot. Or perhaps the four-door sedan will be offered by one make, and the variants by the other.

Design Time Reduced to Three Years by 2000

Actually, a serious debate is taking place within the group concerning the advisability of continuing to develop directly competing lines at Citroen and Peugeot, as was done until now. Built on the same technical bases,

models of the two makes might in the future overlap and complement each other rather than compete for the same market sectors. In view of its modest sales, as compared with its objectives, Peugeot is considering a reorientation of its product positioning strategy. But no decision has been made yet. With its new vehicle design methods, the group intends to increase both its flexibility and its innovative capacity, while progressively trimming lead times. "If our upstream work is well done, we shall be able to design our vehicles in three years starting in 2000," one of the group's engineering managers assured us.

Peugeot's cultural mutation is well started. Unfortunately, it may be quite late. In Europe only, General Motors has already designed its brand new Opel Astra in three and a half years. And it took less than four years for Renault to develop its forthcoming mini-car. The fable of the hare and the tortoise may well apply to the privately-owned French group: slow and steady wins the race.

[Box, p 24]

Peugeot's Next Models

- 1993: replacements for the Citroen BX and Peugeot 309.
- 1994: van similar to the Renault Espace, at Peugeot and also at Citroen; replacement for the Citroen AX.
- 1994-1995: replacement for the Peugeot 405.
- 1998: replacement for the Peugeot 605 and Citroen XM.
- 1999: replacement for the Peugeot 205, for the 309 successor, and for the Citroen ZX.

European Consortium To Produce Fiber-Reinforced Plastic Car Engine

92WS0706D Toddington NEW MATERIALS INTERNATIONAL in English Jul 92 p 8

[Article: "Spain: Plastic Engine Team Win a Bright Award"]

[Text] Although work in Ford's plastic engine (under a BRITE programme) has been concluded, Ford claims it has already made progress in its development work on fibre-reinforced composites. Many of the lessons learned from the project will be incorporated in forthcoming Ford products, the company adds.

Early examples of this will first be seen in motorsport versions of the company's new cars, where further evaluation can be undertaken. Escorts and Sierra RS Cosworth motorsport derivatives will be fitted with undershields made from electroformed moulding tools, using materials which are combinations of those used in the plastic engine's sidewalls and oil pan.

The use of these materials and of new techniques in manufacture will permit major reductions in the cost and the production lead time for fibre reinforced components.

Recently a European consortium of universities and component manufacturers led by Ford engineers received a special award for its work in designing, developing and testing a plastic engine. The award came from BRITE-EURAM II, the European Community's collaborative research programme in the area of industrial and materials technologies.

The award was presented during BRITE-EURAM II's Expo 92 conference in Seville. It recognises the potential environmental benefits of the engine, which in the course of testing revealed significantly lower levels of noise and improved emission and fuel efficiencies, when compared with a conventional power unit.

The project to produce the plastic engine had been under way for three years when it was completed in 1990. The consortium, led by a team of Ford engineers working at Ford's Research and Engineering Centre at Dunton, Essex, involved Nottingham University, the National Engineering Laboratory in Glasgow, GKN Technology, DSM Resins and DSM Research of the Netherlands, Vetrotex St. Gobain of France and Galvanoform of Germany.

The experimental 1.04-litre single overhead camshaft four cylinder engine has two inlet and one exhaust valve for each cylinder and, after laboratory testing, completed a road test programme in a Ford Fiesta. The design uses metal for its combustion chambers, cylinders and moving mechanical parts with an assembly of bonded plastic shell mouldings supporting the core structure.

This concept required the development of special fibre-reinforced plastic (FRP) materials for stressed components. In the plastic engine, these FRP materials are used to form the sidewalls and the front casing, which effectively replace the outer skin of a conventional cylinder block. This load-bearing assembly also carries the alternator, twin distributerless ignition coils and oil pump. The cam cover and oil sump pan are also moulded in FRP.

BIOTECHNOLOGY

German Researchers Making Progress on Malaria Vaccine

92WS0747A Duesseldorf VDI NACHRICHTEN in German 3 Jul 92 p 17

[Article by D.P.A.: "Joint BMFT-Industry Project: Malaria Vaccine in Sight; Procedure Already Successful in Tests With Animals"]

[Text] Bonn, VDI-N, 3 Jul 92—The World Health Organization (WHO) estimates that there are annually about 105 million new cases worldwide of people becoming

infected with malaria. The only way of protecting oneself against infection today consists of taking medications that kill the parasite. However, because of the serious side effects of this chemotherapy—particularly damage to the liver and the eyes—it can only be used for a short time, not permanently. This is why researchers are trying to develop a vaccine that will afford permanent protection. In so doing, they have now made their first advances, the Ministry for Research and Technology (BMFT) recently reported.

A joint project of the Behring Works (Marburg), the Pasteur Institute (Paris), and the Max-Planck Institute for Biochemistry in Martinsried, promoted by the BMFT, is alleged to have successfully produced certain components of the malaria pathogen employing biotechnical methods and combined them in such a way that they were successful in tests conducted with animals. But, whether these results can be applied to humans is still an open question.

A big problem in developing a malaria vaccine lies in the fact that the pathogen—a unicellular parasite—goes through various stages in the human body, attacks different cells in the liver and in the blood, and repeatedly changes its points of attack on the immune system. A prerequisite to the production of a vaccine is therefore to first identify the effective antigens, that is, those structures of the parasite that trigger a defense reaction of the immune system in the human body. Some of these antigens have now been identified in the malaria pathogen's blood stage, according to the BMFT. Whether there are enough of these antigens in humans for a vaccine, however, is yet to be determined.

German Biotechnology Firm Produces Anticancer Drug Interleukin-2

92WS0747B Duesseldorf VDI NACHRICHTEN in German 3 Jul 92 p 17

[Unattributed article: "Current Market Value of First 1.2 Grams Is DM1.44 Billion; Anticancer Drug Produced: Interleukin-2 Gives Patients Hope"]

[Text] Braunschweig, VDI-N, 3 Jul 92—With the help of animal-cell cultures, scientists of the Society for Biotechnology Research (GBF) have succeeded in producing 1.2 grams of interleukin-2 (IL-2) with a current market value of DM1.44 billion in a continuous process lasting five weeks. Interleukin-2 is a potential treatment for immunodeficiency and cancer. Costing DM5,000 per injection, treatment with IL-2 is very expensive, even though very small amounts are needed for a treatment.

With the cell culture technique, animal cells were cultivated in a 100-l fermenter to produce IL-2 and 2,000 units of the resulting solution each containing 1 interleukin were produced. This is a standard corresponding to industrial production. There are hundreds of other compounds in the resulting solution aside from the IL-2. The purpose of the reprocessing operation is to fish out the desired product from this multitude. This is accomplished especially by means of so-called chromatography steps, which take advantage of differences in component size, electrical charge, and solubility in water, among others. Reprocessing yielded a product containing 30 percent [interleukin-2].

COMPUTERS

UK's Expert System Base Analyzed

92BR0509 Paris LA LETTRE DE L'INTELLIGENCE ARTIFICIELLE in French Apr-May 92 pp 9-12

[Text] The British Department of Trade and Industry (DTI) commissioned a survey on expert systems in Great Britain in 1991. The survey was carried out by telephone interviews with nearly 200 British companies out of an estimated 700 companies working with expert systems. The conclusions indicate in which fields innovatory companies apply expert systems and how they are being generated and used. The survey does not allow conclusions to be drawn about the rate of penetration in British industry as a whole. The following are its main conclusions.

Fields of Application

Applications in manufacturing are mentioned first and foremost totaling 33 percent of responses; second come applications in sales assistance, after-sales service, and marketing.

Table 1: Fields of Application

Production	33 percent
Marketing	18 percent
Financial management	12 percent
Personnel and training	8 percent
Information technology support	6 percent
Data management	6 percent
Statutory applications	5 percent
Product development	4 percent
Security	2 percent
Telecommunications support	2 percent
Stock control	1 percent
Other	3 percent

Functionality

The main functions for which expert systems were developed are primarily diagnostics and advice. It is surprising to note that the use of expert systems for prognosis is rarely mentioned.

Table 2: 'Expertized' Functions	
Diagnostics	19 percent
Advice	19 percent
Evaluation	18 percent
Decisionmaking support	12 percent
Activity follow-up	11 percent
Planning	10 percent
Prognosis	3 percent
Configuration support	3 percent
Design and modeling	4 percent

According to the companies surveyed, 30 percent of operational expert systems were developed in less than six months; 42 percent, in less than a year. [Table 3 omitted]

Hardware

Some 58 percent of the hardware used for expert system generation are PCs; for operational expert systems, this percentage rises to 63 percent. Finally, most of these (60 percent) operate in stand-alone mode and are not integrated nor linked to the company's information systems. The all-important integration of expert systems is not implemented in British companies, according to the survey.

Table 4: Computer Systems	
Central processing unit	15.69 percent
Minicomputer	9.80 percent
Workstation	11.76 percent
PC	62.75 percent

Application Software

No single software tool or artificial intelligence [AI] language dominates for the development or operation of expert systems. Nonetheless, nearly 50 percent of operational systems were built with standard, off-the-shelf expert system generators in their two versions (development and user). AI-environment-based software tools such as Kee, Art, or Loops only represent 11 percent of applications and rank behind conventional languages such as C or Pascal.

Table 5: Software Tools and Languages	
User version of ES generator	49.41 percent
AI environment	11.76 percent
AI language	14.12 percent
Conventional tool	9.41 percent
Language	15.29 percent

Development Problems

No major difficulties were encountered during the generation of an expert system: the most frequently mentioned difficulty, i.e., the gathering of expertise knowledge, was only an obstacle in 25 percent of cases. Nevertheless, it is surprising to note that 20 percent of difficulties were software-related. The methodology of the survey does not permit any explanations for this opinion.

Table 6: Origin of Difficulties Encountered	
During applications	3 percent
Hierarchical structure	5 percent
Project management	17 percent
Maintenance	8 percent
Hardware	9 percent
Development capacity	9 percent
Methodology	12 percent
User support	15 percent
Staff acceptance	16 percent
Expertise	25 percent
Software	20 percent

Advantages

The advantages due to the use of an expert system within a company are primarily linked to productivity; the expressions used to explain these advantages are time saved to carry out a job, cost reduction, and improved productivity. Quality improvement is mentioned in more than one out of three responses. However, the survey does not reveal improvements in the areas of maintenance, sales revenues, or the adaptation of the company's products to demand. Apparently, expert systems do not help companies innovate their own markets.

Table 7: Advantages	
Time saving	45 percent
Cost reduction	36 percent
Quality improvement	34 percent
Productivity improvement	33 percent
Reduction in decisionmaking time	16 percent
Reduction in training time	14 percent
Improvements in management	12 percent
Improved equipment utilization ratio	10 percent
Reduction in staff qualification levels	7 percent
Reduction in financial losses	5 percent
Increase in revenues	4 percent
Adaptation of products to demand	4 percent
Improved training	3 percent
Improved maintenance	3 percent

Future of Expert Systems

The future of expert systems, as seen by the 200 respondents, seems promising. Over 60 percent intend to expand, in the short term, their expert system base. Over 10 percent anticipate more than five new developments. "The climate seems quite favorable, not only in large companies but also in small- and medium-sized ones," according to the authors of the report. Expert system developments will not happen without technical or human difficulties but, as a general rule, users are satisfied with the systems they are using.

Japan

In 1990, a survey on expert systems in Japan was carried out by JIPDEC [Japan Information Processing Development Center] along similar lines to the British study. The same kind of survey was carried out in 1988 in France by EC2 and the CEGOS [General Commission for Scientific Organization]. The French survey is too old to be used as a valid comparison in 1992. However, the following similarities and differences are noted between the Japanese and British surveys:

- Diagnostics applications are widely mentioned in both countries. Planning and prognosis come second in Japan and only sixth in Great Britain; the British put evaluation and advice in second place.
- The difficulties encountered in collecting and updating expertise know-how rank first in both countries. Staff shortages seem to affect Japan but not Great Britain.
- The advantages sought and obtained are similar: time saved and improved quality of work. The Japanese study, however, did not mention cost reduction as an objective.
- The hardware base used is not the same: In Japan, there is a marked preference for workstations, whereas Great Britain prefers PCs. However, the proportion is practically the same (about 15 percent) for expert applications on mainframes.

EUREKA Project on Computer-Aided Rapid Prototyping Launched

92WS0773E Toddington NEW MATERIALS INTERNATIONAL in English Aug 92 p 7

[Text] A European research and development project to develop Computer Aided Rapid Prototyping (CARP) technology has been launched by a consortium comprising a number of original equipment manufacturers, software developers and an academic institution. The three-year project is being organised under the auspices of the EUREKA programme and enjoys financial support in the UK from the Department of Trade and Industry.

The consortium is led by Ricardo Consulting Engineers, and includes the CAD/CAM Data Exchange Technical Centre, Delcam International Ltd, Webster Mouldings Ltd and University of Leeds of the UK, Volkswagen AG of Germany and Dott Vitoria Gilardoni SpA of Italy.

The objective of the project is to integrate computer-based design, analysis and manufacturing methods. At the core of the programme is the development of procedures for the highly resolved and accurate representation of components using 3D CAD models. The associated analytical and fast free form fabrication (FFFF) manufacturing technologies will be adapted to use this computer definition of component shape.

Such a system, it is said, will allow the rapid generation of complex prototype parts to a high degree of accuracy. It will thus be possible to design, evaluate, optimise and prototype new products in greatly reduced time scales compared with currently available technology. Companies using CARP technology will enjoy competitive advantages in terms of both product time-to-market and development costs.

DEFENSE R&D

French Industry's Reaction to Defense Budget Cuts

R&D Conversion

92WS0656A Paris INDUSTRIES ET TECHNIQUES in French 8 May 92 pp 56-61

[Article by Andre Larane: "Disarmament: Opportunity for French Industry"]

[Text] The downsizing of military budgets is unavoidable and durable. Suppliers must make the best of it and adopt more aggressive diversification policies. By exploiting their greatest asset: their R&D potential.

To hear leaders of the Council of French Defense Industries [CIDEF] talk, no one worries more than they about the security of France. True, CIDEF's membership includes several hundred enterprises and could be described, after a fashion, as the nation's "military-industrial lobby." They constantly point to the Gulf War as proof of the threat posed by Third-World dictators. The recent interventions of the United Nations in Yugoslavia and elsewhere are cited to illustrate instability in the world. In short, the industrials are trying to convince the government not to lower its guard.

At the same time, they know very well that these new dangers simply can't compare with those posed by the Cold War between 1978 and 1983. No one misses the Golden Age of the arms race, when Brezhnev and Reagan were competing both in the stars and in Afghanistan. Not even CIDEF dares to suggest there should be no reductions in the military equipment budget, which currently stands at about 100 billion French francs [Fr] per year, in addition to Fr30-40 billion in export orders. What it seeks is a fundamental rethinking of our defense and the launching of new high-technology programs. Defense Minister Pierre Joxe certainly agrees there is a need for progress in fields such as telecommunications and satellite intelligence, which experience shows will play a preponderant role in future conflicts. But there is not much chance this will lead to large investments.

The programs already under way, launched before the fall of the Berlin Wall and the end of the Cold War, make up such a large part of the equipment budget that aborting them is scarcely a viable option, while at the same time they leave no room for additional outlays. Two other factors will tend to keep government orders and exports permanently depressed. First, the dynamic growth of basic and medium-technology industry in such newly industrialized countries as Brazil, Taiwan, Israel and Korea (Taiwan's expected purchase of 120 Mirage will not reverse the downward trend in exports). Second, the building of Europe will lead to a rationalization of high-technology defense industries, currently overbuilt. With the arrival of Europe, French industries are losing their favorite argument, namely that support for their activities guarantees national independence and competitive costs for France's own defense.

"The dual-source policy pursued by the Ministry of Defense is less and less tenable," argues Jacques Teyssier, deputy general manager of Aerospatiale, who goes on to criticize Thomson-CSF's plan to buy out the U.S. company LTV and thus compete in the missile market against Aerospatiale and Matra. France's policy of maintaining several manufacturers in the same line out of concern for security has proven costly and counterproductive in the long term. A restructuring is inevitable in the face of European integration. One example is the recent merger of the helicopter divisions of Aerospatiale and Germany's MBB (Daimler-Benz) into Eurocopter. Our European neighbors are restructuring their own defense industries, as attested by the creation of Alenia in Italy and the reorganization of Deutsche Aerospace (DASA).

We must get used to the idea of a profound crisis in defense-related industries. It has already begun in France as well as other western countries—and has already led to social problems. Pierre Joxe's decision to eliminate or shift more than 12,000 posts has had a catastrophic effect on Strasbourg, Cherbourg, Amiens and several dozen areas where garrisons are located. About 380,000 Frenchmen earn their living in weapons production. Out of this total, 60,000-70,000 will be affected [i.e. by cutbacks] between now and the end of 1994, according to CIDEF projections. The people most threatened are those in the least-skilled jobs. Arms makers will have to reduce manpower to improve productivity. Converted into a common-law company in July 1990, Giat Industries—which comprises the former ground weapons makers—has seen its work force reduced from 16,000 in 1987 to 12,000 this year. Unskilled workers were hardest hit. According to officials, the group still has too many supervisory and administrative employees.

In high-technology enterprises, industrial electronics for example, cutbacks and transfers are the order of the day: early retirements at Dassault Electronique, emphasis on internal recruitment at Thomson-CSF. External recruitment is beginning to decline. Fewer and fewer vacancies are being filled.

But most observers agree that few engineers and researchers are being sacked. The arms builders use advanced technologies (electronics and materials) that require lots of gray matter. They have a wealth of material and human resources available for research. This potential is a precious asset for the munitions makers as they try to get out from under the recession and diversify. It constitutes a unique opportunity for French industry as a whole to overcome its technological backwardness. "At any rate, I think the arms industry is better prepared for economic upheaval than the steel industry, for example," says Pol-Ivan de Saint-Germain, head of the Directorate of Technical Research and Studies (DRET) in the General Delegation for Armaments (DGA). Entrepreneurs, resigned to the need to move into civilian applications, are quietly saying the same thing.

Diversification has become a top priority. One remarkable and already historic example is that of CATIA, a CAD/CAM [computer aided design and manufacture] software program that sustains Dassault Systemes (800 employees). CATIA is sold worldwide today, thanks to a successful commercial arrangement with IBM. Matra Datavision's "Euclid" is another software success story. Another no less spectacular spinoff for Matra is the VAL driverless subway. This automated transport system makes use of [computerized] analyses of breakdown modalities, components able to withstand a wide range of operating temperatures, and the electronics cards developed by Matra in its space and military projects.

One perennial debate is whether the civilian spinoffs of military (and space) R&D are really indispensable for the vitality of the industrial fabric. Despite the pervasive austerity, research remains a high priority for the government, which in 1991 allocated Fr82 billion for it, Fr34 billion of which went to military R&D. The accent today is on so-called "dual" research, capable of both civilian and military development. For this reason, there is increasing collaboration between defense, CNRS [National Scientific Research Center] and industries, including joint laboratories such as LETI [Laboratory for Electronics and Data Processing], ETCA [Central Technical Weapons Depot] and ONERA [National Office for Aerospace Studies and Research].

The big defense-related enterprises devote 20 to 30 percent of their gross income (including government subsidies) to R&D. With varying degrees of enthusiasm, they express high hopes for dual-use manufactures. "For the last two years, we have been selling our technology and know-how in ASICs [Application Specific Integrated Circuits], UHF, CAD and hybrid integrated circuits," says Philippe de Braquilanges, commercial director for industrial activities at Dassault Electronique. "We are even going to make finished products for such sectors as transport, oil, telecommunications and electrical engineering." The same refrain can be heard at Thomson-CSF, in the SDC [Defense and Controls Systems] division which has a signal processing laboratory that is developing radar processing systems for both military

and civilian use (the division is the world leader in air traffic control). The civilian share has been on the increase for several years and is now on the order of 30 percent. "We are under the gun to find more fields of joint application," admits one engineer. "And it's not easy, even though civilian applications require increasing technological sophistication and benefit from military developments such as signal filtering via ASIC circuits."

An official in the infrared thermal camera division of SAT [Telecommunications Company Limited] points to similar constraints: "We're doing all we can to reduce the retail price of our products, to get into the civilian market" (with such applications as nighttime premises surveillance and forest fire prevention). Overall, SAT is only 25 percent dependent on the defense market for its turnover, so it is relatively calm about things.

But "duality" is not easy to manage, admits one Dassault Electronique engineer: "The quality requirements for civilian and military applications are quite different, sometimes even incompatible. Here, the demand is for dependable industrialization procedures, with strict cost controls; there, the demand is for ultra-guaranteed products." In the military domain, with very small production series, technological design cannot readily be brought up to date. Instead, one must push for maximum quality in the preliminary studies and initial design—and then stick to it. This is why Dassault Electronique, like any other manufacturer in the sector, is still fabricating equipment designed 20 years ago. In mass production for the civilian sector, one can if necessary revamp the design after a pilot production run.

Top-level managers also point to the limits of duality. "We aren't aware of many dual products. There are a few, but only on the margins, for example in telecommunications, where microwave links are the same in military and civilian applications," says Francis Le Menestrel, deputy general manager of SAT and president of CIDEF. Dual research, as he sees it, is valid over the longer term but does not offer a quick fix for declining markets. The preceding examples give a distorted picture of the impact of weapons technology on innovation. "It is not often true that military research produces civilian applications," confides a research official at DGA. "The most effective transfer is when researchers leave defense to take employment elsewhere!" In technologies which *a priori* have dual use, the gains to be made in research are small in comparison to the costs of development for the civilian sector.

"Civilian industry is distinguished by its capacity to innovate under pressure from world competition. In military programs, on the other hand, efforts tend to get bogged down in procedures," responds Aerospatiale's Teyssier. The same attitude is evinced by a DGA official, who says "it is clear the arms industry is insufficiently oriented towards marketing." The industries concerned are trying to respond by overhauling their marketing strategies: on the one hand, by a strict separation of civilian from military activities, on the other hand, by the creation of commercial and marketing directorates. The first strategy has been implemented by Dassault Electronique. The company has kept only its space and arms activities; a year ago it created an independent subsidiary, Dassault Electronics Process Control and Telecommunications (DEAT), to handle automatic tellers and electronic fund transfers. In this way it has tried to separate two very different modes of operation.

The second strategy has been pursued by Giat Industries. "A commercial and marketing directorate was created in 1989 to promote exports," explains Pierre Marcajoux, director of human resources. Half the turnover in ground weapons—on the order of Fr8 billion a year in all—is generated by exports. That share is going to increase. Giat Industries has just created a new branch, Gitech (Giat Technologie), devoted to dual diversification in engineering and hydraulics. Gitech has personnel in all the [Giat] facilities, and it is looking for civilian applications and alliances in complementary engineering fields.

For suppliers and subcontractors, the recession has brought a radical change in activity. "Of necessity, we have moved from passive marketing, in the form of DGA contracts renewed year after year, without putting any effort into exports, to a more aggressive approach," admits Guy Nicolas, research director at Cime-Bocuze, a subsidiary of Pechiney specializing in fabrication of alloys by sintering, primarily for military applications (munitions). "The annual military endowment was a great comfort," he continues. "We knew from one year to the next what we had to produce. Now, in our medium-caliber munitions, we are plunged into uncertainty. We cannot say how many projectiles we will sell in the years or even months ahead." Marketing executives already are beginning to think like their counterparts in the civilian sector, and the tendency is growing. The market in medium-caliber munitions has become totally competitive, whereas the missile market still depends on juicy government contracts. With the help of Giat Industries' new-found aggressiveness, Cime-Bocuze has entered some foreign markets.

Roger Chamroux is the CEO of Amefo, a machine welding company based in Chambilly (Saone-et-Loire). He serves as a subcontractor for the munitions makers and admits he's glad for the work, at least when demand is brisk. "Contracts with DGA and the suppliers are generally for an extended period. Twenty-four months of firm orders certainly lets us breathe easier," he says. "Payment periods are theoretically somewhat shorter in the private sector, but in reality there is not much difference. The principal advantage is having a financially solvent debtor, which simplifies relations with the banks."

But watch out for unpleasant surprises. At its Roanne facility, which is building the new Leclerc tanks, Giat Industries in early 1991 expected a 1.8-million hour workload for the year—30 percent over its production

capacity. By summer, the workload had been cut back to 900,000 hours! This entailed a cut in manpower from 3,000 to 2,300 and a massive repatriation of subcontracting activity. And the story isn't over yet. If the rate of production is reduced, as expected, to less than 10 per month (700 over 10 years), 800 employees might be enough to do the job!

Subcontractors and suppliers of state-owned companies and assemblers must depend on repatriation of activity. "I know enterprises with several hundred employees that do only defense-related work. They're the ones in danger. They're jeopardizing their long-range survival for the sake of short-term profits," grumbles one munitions engineer. A former DGA director once recommended that no industrial do more than 33 percent of its business with the military, for the benefit of all parties concerned.

Amefo illustrates the danger of this dependence... and the possibility of escaping it. Twenty years ago, the company did nothing but subcontracting for Potain, building cranes and subassemblies. CEO Roger Chamroux looked for a way to diversify into the defense sector. So he did jobs for the Roanne facility, then built shells for light Panhard vehicles. Eventually, 80 percent of his turnover came from military production. His last big contract with DGA ends this year. The CEO, desirous of disengaging from a weakened sector, has put the company's know-how to work to develop vehicles for transporting money, with coachwork of his own design and chassis by RVI, Iveco or Mercedes. He has just received an initial order from Securipost. Does he regret the detour into military contracting? "Not at all. It helped us achieve greater precision and higher quality," Chamroux explains.

The company clearly benefits from its Defense Ministry quality certification. It was in 1980 that the ministry began its enterprise certification campaign with suppliers. No less than 2,500 quality control regulations (RAQs) were issued by the Arms Industry Monitoring Service (SIAR) of DGA. To meet those standards, the industries submit to regular and rigorous factory inspections—one hour for every 300-400 hours of work. The system is perceived as basically advantageous, albeit constraining in terms of record-keeping (detailed production histories). "Our work under RAQ 1 standards greatly facilitated our move toward ISO 9001 certification," says Regis Pecheyran, general manager of Thermodyn, a Creusot-based enterprise that makes turbines and compressors for the military and the oil industry.

According to Roger Chamroux, "this level of dependability—the studies, the methods—has made it easier for us to market our money transport vehicles and get short-term contracts, such as housings for the TGV [high-speed train] and train-car chassis for Transmanche." The problem, if it can be called one, is that the enterprises concerned are no longer competitive in low-end products. But after all, isn't that a salutary way of upgrading industry?

[Box, p 56]

Researchers Looking

The Defense Ministry enriches the industrial fabric through the researchers it trains in its laboratories, who eventually move on, some to the "military-industrial lobby," others to the civilian sector. There is a shortage of civilian researchers today. As a result of current economic conditions, their numbers are expected to grow, to the benefit of industries of every kind. Departing researchers take new jobs making 1.8 or 2 times their previous salary, and defense laboratories cannot stop the drain.

To maintain their human resource base, they are stepping up activity in the field of research training. The number of thesis research scholarships funded by DRET has grown from 20 in 1986 to 80 in 1992 and is expected to reach 100 in 1993. The Directorate of Naval Construction will offer 30 (there were none in 1985). The research training program involves close to 800 researchers, some of them at the great defense colleges (Polytechnique, National Higher School for Advanced Technology, Higher Aviation School).

Military R&D expertise encompasses all the "hard sciences":

- materials (composites, steels, etc.), characterization and evaluation techniques (infrared surface definition, for example);
- solid-state physics, structural engineering (vibration problems);
- informatics, process control and robotics, applied mathematics and digital simulation;
- aerodynamics, internal fluid mechanics (chemical industry reactors, motors, etc.);
- optronics and high-powered lasers;
- energy, propulsion, explosives.

Aerospace Industry

92WS0656B Paris INDUSTRIES ET TECHNIQUES in French 8 May 92 pp 58-61

[Article by Thierry Mahe: "Anticipate, for Survival"—first paragraph is INDUSTRIES ET TECHNIQUES introduction]

[Text] PMIs [small and medium-sized industries] in the Aquitaine region are facing up to the shrinkage of military budgets. The workload of some aeronautics subcontractors has declined by half since last September. Some are taking it tamely... others are striking back.

The Aquitaine region, with its historical and deep ties to the aeronautical sector, is facing the most serious crisis in its history. While it may be too late for tears, experience shows the "ostrich" strategy is not much better. What we are seeing with this recession is the breakdown of an entire industrial system.

The Aquitaine Chamber of Industry [CII] has just published the results of a survey taken of 250 PMIs. It is the most ferocious indictment ever compiled against the prevalent system of industrial monoculture. The report, backed by statistics, shows that "subcontracting companies deal with a small number of order-placers, most of them other businesses in Aquitaine. Out of the 40 order-placers cited, only two are foreign." More than 60 percent of the PMIs in the Aquitaine region are linked to the aeronautical, space or military sectors. And in a big way: It is estimated that close to half these subcontractors derive more than 50 percent of their sales revenues from these sectors. So it is no surprise that "the workload of some PMIs has declined as much as 50 percent in the space of three months (since September 1991)."

Even if one subscribes unreservedly to the CII's indictment, one may smile at its proposals. Among other drastic remedies, the CII calls for "an emergency plan, like the one implemented in the Nord region at the time of the textile crisis." Considering how successful the textile plan was...

Some enterprises have withstood the shock better than others... because they prepared for it. It might be of some interest to examine how they did so.

Investment policy is not just for giant establishments! Applications Vernis Peinture (AVP, [turnover of] Fr3.5 million, 12 employees) is a typical small subcontractor in the aeronautical sector, relying on the latter for 80 percent of its turnover. Specializing in printed circuit coating and small metallic part paintwork, this PME [small/medium sized enterprise] was hit hard by the budget reductions in November 1991. CEO Gerard Lacoste says: "We survived the jolt, because four months previously we had invested Fr200,000 in a baking oven for industrial paintwork." This enabled it to reconvert quickly to industrial paintwork, especially in aluminum joinery. Lacoste was also looking ahead to the possibility of taking subcontract work on mass consumer products.

Composites Aquitaine (150 employees, Fr83 million turnover) is making use of its composite materials know-how. Initially (in the fat years) this 44 percent owned subsidiary of the Aerospatiale group was content with its role as subcontractor in the fields of ballistics and space. Since 1984, it has been disengaging from defense-related activity. Its marketing director, Jean-Louis Zulian, asserts: "From 100 percent, the space and aeronautics share (civilian and military combined) has fallen to just over 20 percent. In 1993, it will be no larger than 10 percent!" Starting in the job two years ago, Zulian has been an active promoter of thorough-going reconversion. First of all, geographically. "In aeronautics, we work with the Toulouse facility, of course, but also with Nantes and Marignane." Second, sectorially, especially the railroad sector. "In 1987 we entered a partnership with Alsthom. Composite materials are a gage of security, the emissions aren't toxic." Its contribution to the automobile sector is more symbolic in nature: Composites Aquitaine provided the [fiber] carbon chassis of the Bugatti EB-110!

Finally, there is a cultural change. "We want to balance our subcontracting activity with products we make ourselves."

At a more fundamental level, what has changed for the business? "First of all, our planning horizon. No more day-to-day management. We carry all our analyses three or four years out. One must search every sector where composites are gaining ground before concluding: These are our market niches! Also, we have invested in research (calculation methods) and in the marketing-commercial group." He concludes: "It's hard to be constantly cutting costs and maintaining discipline when you've been living on a fixed income... " No Hungarian industrialist touting the virtues of the market economy could have said it better!

Composites Development with its 110 employees is another company that has managed to keep its head above water. Its lifeboat is civil aviation—at the international level. The Merignac-based company entrusted its commercial division to an expert in the field, Laurent Sevellec, a former colonel and purchasing official in the air force.

"We saw a sharp decline in turnover in July 1991. It was about this time that negotiations with various international airlines (especially from the Maghreb) began to pan out." What this PME handles is the most delicate part of aircraft maintenance. "Today, we are harvesting the fruits of an assiduous search for overseas subcontracting work."

Diversification to domains other than aeronautics is coming more slowly. "We are looking for domains where there's an opportunity for real innovation. For example, studies of airborne refrigerators to transport food commodities, like those used to transport human organs... In these niches, we have hardly anyone but the English and Japanese to contend with."

The case of Etablissements Robert Creuzet (Fr167 million, 380 employees) is a little different because—according to one of its executives, Martine Graziani—"95 percent of our activity is related to civilian aviation." Granted, this PME is a subsidiary of Fokker, whose workload is mainly civilian... But here one finds a definite reluctance to venture far from its original domain. "It would be difficult to change to a different sector: Aeronautics is our vocation!" Etablissements Robert Creuzet's two key technologies, light alloy extrusion and electrochemistry, have barely secured it a few outlets in the nuclear industry. For now, the PME's policy is "to bear up and hope for recovery in the world economy. We are using the slump in activity to look into ways to cut costs... and train personnel to be multifunctional."

The spontaneous generation of small high-technology companies is a hopeful sign. The Bordeaux technology center (Technopolis) is attracting many of these newcomers, such as Hyperfield (staff of four). Formed two years ago by two electromagnetics specialists, it peddles a surprising spiel which not long ago would have been taken for heresy: "Electromagnetic waves are everywhere, not just in the military! We don't mean to waste time asking for the blessings of the big groups. Responsibility is too diluted there, decisions take too long to make..." Bernard Guillou, Hyperfield's CEO, knows whereof he speaks: He came from Aerospatiale. This new attitude—so removed from the "feudal" policy long pursued by the industrial groups—got the company off to a spectacular start in the field of wireless telephones. And it has made waves far beyond the Gironde!

[Box, p 60]

For more information: "Science and Defense Talks," 12-13 May at Cite des Sciences de la Villette (Paris).

With this two-day workshop, defense plans to intensify exchanges with the scientific and industrial communities. Four themes have been chosen: space technologies, information and communications systems, acoustics and vibrations, and mobile robotics. Also there will be a presentation on EUCLID [European Cooperation for the Long Term in Defense]. Some 1,500 people are expected to attend. A rare chance to discover new technologies or—better yet—future partners.

[Box, p 60]

Projected Losses

CIDEF industries are feeling the effects of budgetary cutbacks. From 1 January 1992 to the end of 1994, nearly 10 percent per year of the 220,000 direct-hire jobs will be eliminated; if subcontractors are also taken into account, it is likely a total of 60,000-70,000 defense-related jobs will be affected. Predictions are equally grim in the other western countries. Between now and 1995, the United States expects the elimination of 500,000 jobs in a sector which employs 3.2 million people and has already lost 250,000 jobs since 1985. Defense-related employment in Europe declined 16 percent between 1989 and 1991.

The aeronautics and space industry, which works largely for the arms industry, is being hit hard by the new geopolitical order. The industrialists' greatest fear is the possible loss of their technological lead and research potential. They are calling for increased government research appropriations. The same situation obtains in industrial electronics (radars, telecommunications, process control, informatics), with the industrials pointing out that in the United States the defense department has increased research funding by 7 percent, despite an 8 percent decrease in the equipment budget. In the field of ground weapons, industrialists are resigned to a significant diminution of turnover. No matter what new equipment priority (if any) may be adopted, they probably will not be the beneficiaries. They would be better advised to turn toward aerospace technologies, electronics or telecommunications.

[Box, p 61]

Budget Reductions

Calculated in constant francs, the 1992 appropriations bill maintains 1991 levels for research, equipment and infrastructure. There is a possibility Fr5 billion of this Fr103.1 billion will be frozen, which would require existing programs to be stretched out. Arms exports, meanwhile, were relatively stagnant in the 1970s, at about Fr55 billion per year (in 1991 francs). The Iran-Iraq conflict and an exceptional order from Saudi Arabia sent exports soaring in 1983 and 1984 to Fr81 billion per year. Just as suddenly, the boom ended. Exports increased again in 1991, to about Fr35 billion. It will be difficult to keep them at that level this year, despite some successes in the Far East. To deal with this problem, the minister last September appointed a delegate for restructuring, Gerard Wolf. The latter works with the big industrials in an effort to revitalize the "employment pools." For example, Renault Vehicules Industriels in Limoges has just created an entity called RVI Development, while in Bergerac, SNPE (National Explosives Company) is participating in an industrialization fund. The DGA's industry mission is working with PMIs to help them (to the extent possible) to diversify their technologies.

Manpower Reductions in the Arms Industries[1]

1992 Situation and Prospects to 1994	Aeronautics and space	Industrial electronics	Ground weapons	total
(Turnover expressed in billions of French francs)				
Unconsolidated turnover (excluding 1990 tax)	118	45	40	132
Unconsolidated turnover from armaments	62	30	40	132
Share of unconsolidated turnover from:				
armaments	52	66	100	65
Of which export share is:	40	48	52	45
Direct employees	120,000	53,000	50,000	223,000
Indirect employees (subcontractors and suppliers)	250,000	46,000	75,000	371,000
Total employees	370,000	99,000	125,000	594,000
of which armament activity accounts for:	190,000	65,000	125,000	380,000
Expected decline of direct employment				
from 1 January 1992 to end of 1994	20,000	9,500	15,000	45,500
Decline of indirect employment	40,000	5,500	10,000	55,000
Total decline in employment	60,000	15,000	25,000	100,000
of which armament activity accounts for:	30,000	10,000	25,000	65,000

1. Source: AVIATION MAGAZINE, from information provided by CIDEF.

France: Dassault Presents Remote Control Jeep Prototype

92WS0667D Paris INDUSTRIES ET TECHNIQUES in French 5 Jun 92 p 85

[Article by Jean Segura: "Dassault Electronics Develops A Remote-Control Vehicle: A Remote-Control Jeep"—first paragraph is INDUSTRIES ET TECHNIQUES introduction]

[Text] This vehicle will perform high-risk military surveillance missions, or tasks in polluted areas.

There will soon be nothing heroic any more about being a "scout." Actually, at the Science and Defense symposium that took place in Paris around mid-May, the General Delegation for Weapons (DGA) presented the prototype of its Dards [Independent Fast-Moving Surveillance Demonstration Unit] remote-control vehicle. This driverless land vehicle can perform missions in the independent mode, or in the remote-controlled mode when it is controlled from a remote piloting station.

In its principle, a robot-like vehicle can include observation means (cameras and various sensors) and action means (handling arm, cup, or other). Sent into a dangerous zone, during military operations (or on polluted industrial sites), it replaces man in performing localization, surveillance, sampling, or mine-clearing operations. Ordered from Dassault Electronique by the Directorate of Technical Research and Studies (DRET), Dards is the DGA's first mobile robotics project of this size. Six other companies are working on the project with Dassault Electronics: Aero, Cyberg, Infodyne, ITMI [Intelligent Machine Industry and Technology], Midi-Robots, and SAGEM [Company for General Applications of Electricity and Mechanics]. The total cost will be 53 million French francs [Fr]: Fr28 million from the DGA and Fr25 million from the companies.

The Dards is a set of two vehicles: one 4x4 jeep working as a robot, and a command post on board a van. The liaison between the two vehicles is provided by a traditional radio transmission system of the HDLC [High Level Data Link Control] type, at the rate of 153 kilobits per second [Kbps] (or 30 Kbps in the remote mode), over a distance of up to 5 km. The robot is a series vehicle, whose driving components—accelerator, brakes, transmission, and steering—are controlled by a number of actuators. Dead-reckoning recalibration components, such as odometers (rpm measuring sensors) and inertial units, as well as a hyperfrequency radar communicating with external markers to permit absolute recalibration enable the robot to reposition itself continuously. On the vehicle roof, a laser range-finder provides a depth image to detect obstacles, and a CCD [charge-coupled device] single-sensor color camera monitors and classifies the obstacles. Inside the vehicle, at windshield level, three cameras arranged fan-like film the road, simulating the eyes of a hypothetical driver with a 150x visual field. The on-board data-processing equipment relies on six Motorola 68020 and 68040 processors and is installed at the rear. It acquires images and data and transmits them to the command station via an on-board transceiver. The

van contains a command-control station, an image-processing station (running on two Silicon Graphics Iris 4D/25) work stations, and the remote-mode control station.

From the van, which remains in a protected zone, the human operator defines the robot's mission: "Go to this place and watch in that direction." If the robot meets an obstacle, it stops a few meters from it. When the obstacle has been identified (by the image-processing system), the robot decides to go around it or to interrupt its mission. The operator is kept informed by its monitoring instruments; he may replan the mission at any time and send new instructions: return to base, new route, etc. If the mission proves too difficult or if the territory is not well known, the system may switch to remote mode. The operator is provided with the replica of the vehicle piloting station (steering wheel, accelerator and brake pedals, and gear selector lever). Facing him, three video screens display the images transmitted by the three cameras of the robot vehicle. The system works in the master-slave mode. This makes it possible to drive the vehicle from a distance.

"Dards version 1 should be fully operational in nine to 10 months," we were told by Catherine Fargeon, head of the DRET mobile robotics department. Driving at 40 km/h, it will be able to detect obstacles laid out at random on its route. Eventually, it should run at 100 km/h on a roadway or a well-marked dirt road, and detect obstacles 150 m away. Already a Dards version 4, suitable for off-the-road missions, is being considered.

Eurofighter Electronic Warfare System Contract Awarded

92WS0678A Brussels EUROPEAN AVIANEWS INTERNATIONAL in English Jun 92 p 6

[Text] The Eurodass consortium has won a development contract worth over £200 million to supply the electronic warfare system for the EFA [European Fighter Aircraft]. Work on the EFA's self-defence sub-system will be shared by the consortium's two partners, Marconi Defence Systems (60 percent) and Elettronica (40 percent). The DASS will be an integrated EW system, which will include passive detection capabilities, on-board active jammers (possibly), as well as an anti-missile warning system.

Germany To Join EUROSAM for Aster Anti-Aircraft Missile

92WS0752B Paris LE MONDE in French 22 Jul 92 p 10

[Unattributed article: "Germany Considers Returning to the Franco-Italian Consortium EUROSAM: For Its Anti-Aircraft Missiles"]

[Text] To replace its old anti-aircraft missiles, of the American Hawk type, Germany is considering returning to the European Consortium EUROSAM, which combines the French groups Aerospatiale and Thomson-CSF and the Italian group Alenia around a generation of anti-aircraft missiles dubbed Aster. Originally, Germany had planned to develop its own weapons system, the Tactical Air Defense System (TLVS), based on know-how from the groups of Siemens, DASA (more specifically, its subsidiary Messerschmitt-Bolkow-Blohm), and Telefunken System Technik. Other candidates were in the running, such as the Super-Patriot (a more modern version of the Patriot used by the Americans during the Gulf War), the ERINT missile from the American group LTV, or the CORPS SAM program which the American army has budgeted to respond to its anti-aircraft missile and tactical antimissile needs.

The Bundestag allocated the German army an initial credit of 140 million German marks [DM] for a so-called feasibility study which will consider the Aster program of the European consortium. The German needs relate to the Aster 30, which is the missile designed by EUROSAM for short- and medium-range anti-aircraft defense. The device more specifically suited to Germany would be developed on the basis of this family of missiles.

ENERGY, ENVIRONMENT

German Ecosystem Research Centers Form National Network

92MI0626 Bonn TECHNOLOGIE-NACHRICHTEN MANAGEMENT-INFORMATIONEN in German 19 Jun 92 pp 2-3

[Text] Ecosystems researchers in Germany, acting in collaboration with international partners, are seeking answers to questions arising from increasing land utilization and consumption of raw materials: for example, what will be the effect of climate change on ecosystems? What form does environmentally-friendly agriculture need to take? How can industry's pollution of the environment be reduced?

Between 1988 and 1992, the BMFT [Federal Ministry of Research and Technology] funded under its ecosystems research priority area the establishment of five high-powered ecosystems research centers: Goettingen University's Forest Ecosystems Research Center, the Kiel Ecosystems Research Project Center, the Bayreuth Institute for Terrestrial Ecosystems Research, the Munich Agricultural Ecosystems Research Association, and the [UFZ] Leipzig-Halle Environmental Research Center.

These five centers have now jointly created the TERN [Terrestrial Ecosystem Research Network], the more effectively to apply and compare the results of their research, including the results of international cooperation, with priority being given to the following areas:

- effects on plants and ecosystems of increased CO_2 concentrations;
- control of energy and water exchange by plants;
- effects on bio-geochemical carbon, nitrogen, sulphur, and phosphorous cycles of global changes;
- land use and trace gas emissions;
- regionalization of ecosystem processes.

The centers are actively involved both in the Man and Biosphere (MAB) UNESCO program and in the International Geosphere and Biosphere Program (IGBP), the purpose of which is to describe and understand the interactive physical, chemical, and biological processes which control System Earth: the knowledge thus obtained is intended to make it possible to predict the consequences of climate changes. The MAB program is intended to devise on an international scale the scientific bases for ecologically viable utilization of natural resources, thereby demonstrating that conservation and human utilization of natural resources can be compatible.

All the centers share an interdisciplinary, unitary approach to research, based on the recognition that "a forest is more than the sum of its trees." Their studies concentrate on the relationships linking the atmosphere, soil, rocks and water reserves, and their links with plants, animals, and microorganisms.

The complexity of these links and interrelationships can be seen from the example of microorganisms (bacteria, fungi, and algae), which play a crucial role in the global cycle of materials. Microorganisms are absolutely essential to the decomposition of organic substances, and the endproducts of their activities are CO_2 and water. Both these substances are reconverted by plants into organic substances through photosynthesis.

Some types of bacteria can convert nitrogen compounds held in the soil, such as nitrate and ammonium, into elementary nitrogen (N_2): this process, known as denitrification, releases nitrous oxide (N_2O) into the atmosphere. This greenhouse gas contributes to depletion of the protective ozone layer, in the same way as chlorofluorocarbons (CFCs). The frequent over-fertilization in farming, together with soil pollution from the atmosphere, can be expected to increase production of N_2O. This pollution is caused overwhelmingly by emissions from industry, traffic, and agriculture: concrete data from arable and pastureland and forests are needed to assess its significance and likely dangers; only when reliable information is available will it become possible to use improved models to make reliable forecasts of future developments. These are just examples of the types of research currently being undertaken in the area of ecosystems.

New models for collaboration are being tested in the ecosystems research centers, addressing issues both of financing and of cooperation. Examples are the agreements between the state of Bavaria and the [BITOK] Bayreuth Institute for Earth Ecosystems Research, and between the state of Schleswig-Holstein and the Kiel Project Center, for these institutions to be gradually absorbed into each state's funding mechanisms. The BMFT is providing major pump-priming financing to strengthen universities' capacity for ecosystems research. The [FAM] Munich Agricultural Ecosystems Research Association, which conducts longterm tests in which ecological agriculture is compared with systematic land utilization making targeted use of fertilization and optimum use of pesticides, provides a model for long-term collaboration between a university and a large-scale research establishment, the GSF Environmental and Health Research Center. The Leipzig-Halle UFZ is the first ecosystems research center to receive institutional funding and to have the capacity to undertake highly-complex interdisciplinary ecosystems research over a long term: the center works closely both with universities and with other institutionally funded environmental research establishments, and is to be developed into a flagship for German ecosystems research.

In addition to these centers, which undertake essentially applied basic and preventive research, ecological researchers are also addressing complex environmental problems through joint and keynote projects. For example, in addition to the work in progress at the Goettingen Research Center into the energy, water, and material resources of forests, intended to draw up guidelines for avoiding future damage to forests, the Dresden Technological University is receiving funding for a large-scale keynote project, "Alterations to the Erz Mountains Forest." These researchers, based in Saxony (Tharandt), are working on a plan for renewing the forests through partial replacement of spruce monocultures by more stable mixed stands, thus achieving a compromise between the demands of ecology, agricultural planning and forestry.

In agricultural ecosystems research, in addition to the work of the Munich Research Association, individual joint projects are receiving supplementary funding. These projects are concerned with such matters as intensive livestock farming and the accompanying nitrate pollution of groundwater in the Vechta district, and developing simulations of the dynamics of nitrogen in soils. These projects are intended to provide ways of avoiding nitrate pollution of groundwater and to produce specific guidance for precise administration of nitrogen fertilizers.

In addition to natural ecosystems such as those of areas used for forestry and farming, since 1991 research has also been conducted through specific keynote projects into problems of densely-populated industrial conurbations, as part of the urban ecology funding priority area. Two interdisciplinary keynote projects concerned with optimizing the water cycle and with ecological aspects of mobility within cities and urban regions are to continue during 1992.

The overriding aim is to apply the results of complex ecosystems in the above keynote projects in such a way

as to restore overstrained ecosystems to a state in which they can survive and be of lasting benefit.

Detailed information on the functions of the above centers and the aims of keynote projects can be obtained from the project leader for biology, energy and ecology (BEO 51), Juelich Research Center GmbH, PO Box 19 13, 5170 Juelich; tel: 02461/61-5544; fax: 02461/61-2730.

German Government Sets Guidelines for Environment Change R&D Program

92MI0652 Bonn BMFT JOURNAL in German Jun 92 p 1

[Excerpt] [Passage omitted] The Federal Cabinet has approved the overall funding plan, "Global Environmental Changes," in good time for the Rio Earth Summit. The plan provides an overview of activities in various research areas and points up areas requiring research, particularly in the following urgent global environmental problem areas:

- Atmospheric changes and resulting global warming;
- Depletion of the stratospheric ozone layer;
- Dangers to the earth's oceans and ice caps;
- Threats to sensitive ecosystems; and
- Threats to the existing variety of species.

The BMFT [Federal Ministry of Research and Technology] is to step up its funding of measures related to global environmental change. German funding in this area totaled around 364 million German marks [DM] during 1990; around DM380 million were spent on this area during 1991. Additional BMFT funding will support development of environmentally-friendly technologies (which received DM147 million in 1991) and renewable energies and efficient energy use (DM310 million in 1991).

A scientific council, "Global Environmental Change," has been set up to advise the federal government; the council will submit an annual report, make recommendations for research and advise on how to avoid harmful developments. The council was constituted on 14 May 1992 in Bonn in the presence of Federal Ministers Dr. Toepfer and Dr. Riesenhuber.

German Government Measures Against Ozone Depletion Outlined

92MI0653 Bonn BMFT JOURNAL in German Jun 92 p 15

[Text] Measures taken by the federal government to prevent depletion of the ozone layer were described by the Parliamentary State Secretary to the Federal Minister for Research and Technology, Bernd Neumann, in conjunction with the Federal Minister for the Environment, Conservation, and Reactor Safety, in response to a question from Bundestag members and the SPD [Social Democratic Party of Germany] parliamentary group. State Secretary Neumann pointed out that 9 million German marks [DM] were available during 1992 under the ozone research program, providing funding for such projects as surveys to investigate stratospheric ozone depletion, especially over the Arctic, associated processes, laboratory experiments and modeling.

Between 1990 and 1994 the BMFT [Federal Ministry of Research and Technology] is also contributing a total of DM3 million towards TRANSALL, equipped by the federal armed forces to carry out survey flights. The ozone research program will shortly include a new component, "Measurement of UV-B Radiation," in order to obtain reliable data on intensity of UV-B on the earth's surface.

The Federal Environmental Minister is negotiating with manufacturers and users of fluorocarbons to phase these out by the end of 1993 if possible, so as to prevent further depletion of the stratospheric ozone layer. The federal government considers that, if such phasing out is to be achieved before the deadline of 1 January 1995 fixed for the halon fluorocarbon order, then it is essential for the appropriate national authorities to act swiftly to approve production facilities for fluorocarbon substitutes. On an international level, both within the EC and at the fourth conference of signatories to the Montreal Protocol to be held in November 1992 in Copenhagen, it is essential for previous measures to be intensified, through:

- Bringing forward to the mid-1990s the phasing out of substances covered under the Montreal Protocol;
- Phasing out the so called transitional substances (hydrofluorocarbons) by the beginning of the next century;
- Limiting overall use of hydrofluorocarbons;
- Restricting hydrofluorocarbons to specific areas of use.

In order to assess the increasing role of air transport in depleting the ozone layer, the BMFT is to fund a joint project, "Pollutants in Air Transport," proposed by the German Aerospace Research Agency and involving not only large-scale research establishments but also aerospace companies, the TUV [Rhineland Technical Monitoring Agency], universities and other research institutes.

Germany: BMFT Funds Study on Advantages Offered by Solar Energy

92MI0654 Bonn BMFT JOURNAL in German Jun 92 p 12

[Text] Solar power stations could significantly assist in the protection of the environment and climate in countries located in southern climatic zones, according to a BMFT-commissioned investigation into the potential for using solar power stations in the Mediterranean region.

By 2005, solar plant capacity in the range of 3,500 to 13,500 MW (depending on energy policies) could be

achieved in economically viable conditions in 16 Mediterranean countries, substituting 4 to 15 percent of the additional oil- and gas-powered plants which would otherwise be needed. On a longer term, to around 2025, solar power stations could bring about a significant reduction in CO_2 emissions in this growing economic region. Every MW of solar power substitutes 2,000 tonnes of CO_2 emissions per year, so that a combination of efficient fossil-fuel power stations and expansion of solar power stations to a total of 23,000 MW by 2025 could at least stabilize emissions at present levels.

CO_2 emissions, currently totaling around 380 million tonnes annually, could be reduced by up to 35 percent through a forced expansion of solar power in the next century of up to 33 percent (63,000 MW) of the expected potential market of 190,000 MW for new power stations.

Such an expansion of solar power would mean a market of between 15 and 60 billion German marks [DM] by 2005, and of DM90 billion to DM220 billion by 2005 to 2025.

A start must be made as soon as possible to extending solar power if it is to achieve this contribution to energy savings and protecting the environment by 2005. The first step could be to commission 300 MW solar power farms of the type trialed in California, using groove collectors in combination with supplementary oil or gas power.

Solar power stations with outputs in the range of 50kw-100 MW could be ready for commercial use within a decade. According to the study, however, expanding their industrial production can only be justified economically if the first projects in the Mediterranean region are implemented as soon as possible, with developed countries giving the financial support of which only they are capable.

Germany: Bacteria To Eliminate Dioxine Studied

92WS0682A Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 15 Jun 92 p 10

[Unattributed article: "Bacteria to Eliminate Dioxine"]

[Text] As part of a joint research project, scientists from the Universities of Bielefeld, Braunschweig, Greifswald and Hamburg are searching for bacteria to detoxify soil which is contaminated with dioxine. According to Professor Rudolf Eichenlaub, a microbiologist from Bielefeld, the project which is supported by the Federal Ministry for Research wants to optimize the bacteria's ability to break down the toxin. Professor Eichenlaub belongs to a research group which studies the biological transformation, detoxification and decomposition of compounds containing dioxine. Through genetic engineering, it should become possible for microorganisms to break up dioxines. The research centers around the biological process of separating the chlorine atoms from the dioxine compound and on the best possible bacterial characteristics. According to reports, bacteria which decompose substances similar to dioxine have already been isolated at the University of Hamburg, however, no solutions to this problem can be expected in the near term.

Germany: New Production Method for Solar Cells

92WS0682D Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 25 Jun 92 p 8

[Unattributed article: "Inexpensive Solar Cells on Window Glass"]

[Text] Research at the Batelle-Institut e.V., Frankfurt, has resulted in a new production method for solar cells. By heating it to approximately 700°C a cadmium-tellurid compound is sublimated onto a carrier material where it causes finely shaped crystals to grow. According to Battelle, common window glass can be used as a carrier. The method is called closed-space sublimation, since the window glass and the cadmium-tellurid blank are brought in very close contact to each other.

The new method allows for high-speed production, so that one installation can produce six square meters of solar cells per hour. Battelle considers this to be the major advance since the large quantities necessary to amortize the very costly machines are only possible with high-speed mass production. According to Battelle, in initial experiments a crystal layer formed on window glass after only two minutes with an efficiency rate of 11 percent.

The goal is now to build an industrial demonstration model as quickly as possible to turn the sample into a competitive product. Siemens AG is the market leader in solar cell production. Battelle estimates production costs to be DM200 to 300 per square meter, so that the installation of a one kilowatt output would cost between DM2000 and DM3000. This figure is up to 80 percent lower than the present price of silicon solar cells. The institute thinks that the thin-layer cells could produce energy and be competitive even with standard electric power stations.

Germany: New Bioreactor for Polluted Water

92WS0682E Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 29 Jun 92 p 10

[Unattributed article: "Rotational Disks as Microbe Carrier—Berlin Researchers Present a New Waste Water Treatment Reactor"]

[Text] A rotational disk bioreactor can be used to clean up highly polluted waste waters. Bacteria which degrade pollutants accumulate on the rotational disks. The method was developed by Professor U. Wiesmann, doctor of engineering, and T. Breithaupt, graduated

engineer, at the Institute for Process Technology of the Technical University of Berlin (Sekr. MA5-7, Strasse des 17. Juni 135, 1000 Berlin).

The bioreactor is based on the observation that many waste waters from the food and beverage industry as well as agriculture are loaded with nitrogen and carbon compounds. Biological methods are preferred for cleaning. If the carbon concentration in the waste water is very high, anaerobic methods are particularly suitable, since there is very little biomass, there are no ventilation costs, and biogas can be obtained. Waste waters with high carbon and ammonium-N concentrations which were found in the waste waters tested require a multi-step process.

To decompose the pollutants the decomposing bacteria are required in high biomass concentrations. Wiesmann and his staff solved this problem by using the rotational disk reactor. This bioreactor contains a horizontal shaft on which 28 disks are arranged which consist of structured textile material with polyurethane foam. According to the researchers, spreading the foam pores with bacteria results in a high biomass concentration.

Excessive biomass is separated by scrapers at the reactor wall and removed. The disk shaft rotates at a controlled speed in the reactor. By varying the speed the dwell time distribution of the reactor can be changed so that it corresponds to a flow pipe on the one hand, and a completely mixed impeller type reactor on the other hand. So far, Wiesmann did practical experiments with a cylindrical laboratory reactor 90 cm in length and with a diameter of 20 cm.

Use of the reactor also made it possible to reduce the nitrogen content in a test waste water from 500 mg per liter to less than 10 mg nitrite-N per liter. According to the researchers, another test reactor will shortly be equipped with an oxygen supply.

Germany: Biochemical Fuel Cells Developed

92WS0682F Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 1 Jul 92 p 6

[Unattributed article: "Microbes Deliver Current for Electrolysis—Dechema: Bioelectrochemical Cell With an Efficiency Rate of Approximately 10 Percent"]

[Text] Scientists at Dechema in Frankfurt (Bioverfahrenstechnik, Theoder-Heuss-Allee 25, 6000 Frankfurt 15) have found a biological method for obtaining hydrogen using a bioelectrochemical fuel cell and attached water electrolysis. The electrical energy required for the water separation can be obtained from the physiological oxidation reduction reactions of intact microorganisms.

A unit consisting of 10 bioelectrochemical fuel cells was attached to operate the water electrolysis. So far, 1.2 ml hydrogen per hour corresponding to 0.6 ml oxygen per hour were produced over a period of three days. The fuel cells were operated with the microorganism Wolinella succinogenes and sodium formiate as a substrate; 2-hydroxy-1,4-naphthoquinone was used as an oxidation reduction mediator.

The bioelectrochemical fuel cell function is based on the following principle: The terminal electron acceptor oxygen is excluded and oxidation reduction dyes (redox mediators) with a suitable potential are reduced in the fuel cell using microorganisms. However, this reaction takes place only if a substrate is present. The reduced mediators can be reoxidized at the anode and are again available as electron acceptors. An oxygen gas diffusion electrode is used as cathode for the bioelectrochemical fuel cell. According to Dechema scientists K. Schenck, D. Sell and G. Kreysa this technology has a number of advantages, as outlined by them in the Proceedings of the 10th Dechema Conference of Biotechnologists: The water electrolysis technology is becoming available for biological procedures as well. The oxygen can be obtained in pure form so that further cleaning is not required. Moreover, the spectrum of microorganisms which can be used for biologic hydrogen generation could also include those which do not themselves generate the hydrogen as a metabolic product.

According to Dechema, the volume of such a fuel cell is 13 ml and the dry weight of the bacteria is 3 grams per liter. When switching 10 cells in series, a voltage of 4.2 V, a maximum current flow of 14 milliampere and a maximum output of 5.4 milliwatts is measured.

Further developmental work on the method also includes the use of other economically interesting nutrient solutions (for instance agricultural waste). So far, glucose and formic acid have been used as nutrients for the microorganisms. Sunlight might be a possibility using microalgae. Another major goal is a further increase in the current efficiency rate of approximately 10 percent.

Swiss University Develops New Type of Solar Cell

92WS0690A Stuttgart BILD DER WISSENSCHAFT in German Jul 92 pp 30-33

[Article by Axel Fischer: "The Dye Formula—A Completely New Solar Cell Generates Renewed Interest in Photovoltaics"]

[Text] A break-through in solar cells? A unit which converts light into energy using a color dye is supposed to be 10 times less expensive than conventional solar cells.

Michael Graetzel likes small electric motors. The window sill next to his desk is full of them. However, he is more interested in the motor drive than in the actual motors. One of the motors has transparent blades with a reddish-brown glow—they provide the energy for the unit.

This scenario takes place at the Institute for Physical Chemistry at the Swiss Technical University in Lausanne. Here, German chemist Graetzel is working on a solar cell whose structure is completely different from that of all known solar cells. The elaborate arrangement copies the principle which plants use to capture light from which they derive energy. The most striking feature: Graetzel's set-up is more efficient than that of nature.

Plant photosynthesis works as follows: Antenna molecules capture the photons of the incoming light, swallow the energy and deliver it to the leaf green chlorophyll. This places the chlorophyll into a state of higher energy. However, this state is maintained for only fractions of a second since it releases electrons in quantities corresponding to the amount of photons taken up. Through a cascade of chemical reactions the electrons migrate away from the chlorophyll through the membrane which contains the photosynthesis apparatus inside the leaf.

However, the plants are not very energy efficient since fully half the photon energy taken up is used for transporting the electron through the membrane. Add to this other energy losses, and on balance a plant uses the energy content of only one out of 20 or 30 photons, or in technical terms: its energy efficiency is between 3-4 percent.

Michael Graetzel also uses such molecular antennas. He turns those semiconductors into solar cells which usually do not use sunlight efficiently.

This development started 20 years ago. At that time, Japanese researchers reported that they were able to separate water into hydrogen and oxygen using light and the semiconductor titanium oxide. Many electrochemists believed at that time that it would only be a small step towards producing cheap solar cells of a similar type. However, they had overestimated the hydrogen yield. Inexpensive, i.e. polycrystalline semiconductor materials had only a very small yield, since the boundary layers where the individual crystals in the polycrystalline material meet interfere considerably with the transport of the charge.

And here is the reason: As is the case with silicon, with titanium oxide the photocurrent is determined not so much by the negatively charged electrons, but by the positively charged holes created by them. Adjacent electrons slide into these holes, and their spaces are taken up by neighboring electrons. At the end it seems as if the open space—the hole—had moved within the crystal. And this hole gets frequently caught in granular edges in the crystal or in impurities. Therefore, the semiconductor silicon can only contain one foreign atom per billion of silicon atoms. For this reason, production of the semiconductor requires expensive clean rooms.

Graetzel is able to save these expenses since he coats the inexpensive semiconductor titanium oxide with a dye which is able to capture light and inject energy into the semiconductor similar to the antennas on the photosynthesis membrane of the leaf. The holes in the crystal grid do not move anymore, rather, the electrons are pumped through the cell.

Twenty years ago, the Japanese did not think of such a combination. Therefore, they could use only the ultraviolet portion of the sunlight with its higher energy. Red light with its longer wavelength does not have the energy to separate charges with titanium oxide. Only when titanium oxide is combined with a dye which makes it sensitive to red light can the remainder of the light in the sun's spectrum be used in addition to the negligible ultraviolet portion.

Scientists had this idea already 20 years ago. Heinz Gerischer, a German physical chemist, had tried to sensitize semiconductors with dissolved dyes. However, the exciting energy dissipated after only one-tenth to one-hundredth billion of a second. However, Gerischer did not give up and soon hit upon the idea to bind the dyes to the surface. However, even a thick layer of dye absorbed only about 1 percent of the incoming light—much too little to be economically feasible.

To change this would have required enlarging the active surface: the more porous a material, the larger its inner surface and the more frequent the chemical reactions which can take place simultaneously. "This is where I actually started," says Graetzel. He came to Lausanne in 1976 to develop very finely distributed catalysts made of ruthenium dioxide which can be used to oxygenate water. Then, the research group switched from ruthenium dioxide to titanium dioxide.

Graetzel had some experience with small particles and with the separation of electric charges. After completing his studies in Berlin he received a scholarship to attend Notre Dame University in Indiana. There, in 1972 he tried to separate charges using soap molecules, so-called surfactants: "This was the simplest way to imitate a membrane." The membrane of a spherical structure composed of surfactants shields the water insoluble (hydrophobic) content from the aqueous (hydrophilic) surrounding, just like a fat droplet suspended in suds. When the surfactant molecules carry an electric charge the complete boundary layer of this so-called micelle is charged.

"At that time, we found out that this charged boundary layer can be used to trigger reactions through light which are not possible in a homogenous medium." Graetzel mentions photoionization as an example: "When an electron moves from the micelle into water, and the micelle carries a negative charge, the electron cannot go back there."

As a result, the charges are separated. A water insoluble sensitizer which is built into the surfactant ball captures the light and releases an electron in return. Each electron which moves through the membrane to the outside leaves a positive charge on the inside. "Already then we thought of using the electrons in the water to produce

hydrogen." Theoretically, this difference in voltage would be sufficient to separate hydrogen from water. However, the sensitizer has to be regenerated if the process is to continue.

In Lausanne, he was faced with the problem of how to work with similarly small dimensions using titanium oxide. Graetzel found the key to his success in the United States. At a conference, he asked a knowledgeable colleague how to produce colloidal titanium oxide, i.e. how to distribute it so well in a liquid that the individual particles behave almost like individual molecules. The recipe which Graetzel got and took back to Lausanne worked flawlessly. Until then, the Swiss researchers had shown very little interest in light. They were primarily interested in the separation from water. However, this changed when they had the minutely distributed titanium dioxide. Now they made every effort to use sensitizers to provide the titanium oxide with visible light.

A research result helped the study team: A student had oxygenated titanium sheet in air, coated the rough surface generated with a sensitizer and measured the current generated by this simple photocell during exposure. Instead of the billionth of an ampere measured by other researchers he obtained a current which was a thousand times stronger. First, his colleagues did not want to believe the results and started to check them out. New layers of rough titanium oxide were produced. This time an organic titanium compound was brushed onto a sheet, sintered in the oven and brushed on again. With this simple treatment the chemists succeeded in obtaining a surface from a layer only 10 nanometers thick which was 200 times larger than that of its smooth counterpart. Again, the photons and the generated electrons were counted, and to their surprise, on average two photons were enough to trigger one electron. "That was when we started to pay very close attention," the 47-year-old chemist recalls.

An article in an American journal was followed by an invitation to spend some time doing research at the highly regarded University of California at Berkeley. On his way to Berkeley, Graetzel attended a conference in Chicago where he met Brian O'Regan, who had been working with colloids for some time. The American was so excited about Graetzel's idea that he followed him first to Berkeley and later to Lausanne. In Berkeley, they worked together in order to build a ceramic membrane using a new sensitizer and titanium dioxide colloids. The unit which measured only three square centimeters, provided "a few milliamperes," Graetzel recalls with pleasure.

In Lausanne, the study of colloids continued. Soon, the researchers found a way to deposit a layer only five-millionth of a millimeter thick onto glass in one step. A surfactant added to the titanium oxide slurry prevented the build-up of voltages during evaporation of the water from the pores and thereby separations. After the surfactant had completed its work it caused no harm: it was burnt up during sintering at 400°C. Now it was possible to produce even layers which previously had depended on the researchers' luck and the vagaries of weather. In addition, the colloidal layer had an even rougher surface and was able to capture even more light. Moreover, glass has the advantage that it can also use light entering from the back. And the thin layer is hardly visible. Only the sensitizer gives the transparent cell a reddish brown color. Researcher Graetzel considers all major problems related to basic research solved. According to him, everything else is technical development and a question of time. By now, under direct sunlight the cell uses 10 percent of the incoming light, compared to 12 or 13 percent with conventional silicon cells. Its main advantage, however, becomes apparent in diffuse daylight. Under cloudy skies, which are frequent in Central Europe, the ratio is reversed: The titanium dioxide cell uses 12 percent of the photons which is twice as much as the conventional photocell.

"If you only want small photocells for consumer electronics, we could start production immediately." But Graetzel and his partners in industry—the Swiss chemical group Sandoz and the electrical group ABB—want more. They have plans for large-surface cells which could provide decentralized energy in the form of windows, for instance. The advantage is that they do not require additional space as is the case with silicon cells. However, these large cells have not yet been built. The glass must be provided with a grid made of thin metal threads to conduct the current, since otherwise too much energy is lost. Graetzel is convinced that initial modules will be available within two years—at sensationally low prices. According to estimates by the industrial partners they will cost 10 times less than conventional solar cells.

Hope For a Breakthrough

At present, success is being reported with comparatively old-fashioned semiconductor materials as well: The Batelle Institute in Frankfurt plans a test production of solar cells made of cadmium telluride (CdTe) for technical evaluation. The method for depositing the layers on window glass is new: At 600 to 700°C, the CdTe is deposited under vacuum from a blank. Battelle estimates the cost to be "up to 80 percent less than the cost for present silicon cells."

Werner Bloss, head of the Institute for Physical Electronics at the University of Stuttgart, also uses thin-layer technology. In cooperation with two other European research teams he is developing copper-indium-diselenid layers which are to be deposited on window glass. Recently, he reported an efficiency of 14.8 percent which was measured in the laboratory. The feverish search for new methods is necessary. While the conventional silicon cell is technically fully developed, it is too expensive to be able to compete with conventional energy supplies.

An Electron Pump With 1200 Revolutions

The heart of the Lausanne solar cell is an extremely thin ceramic semiconductor layer made of titanium dioxide

whose pores measure only one-hundredth of a millimeter. The titanium dioxide is coated with a dye which generates electrons using the incoming light and releases them to the semiconductor material. From there, electrons can be withdrawn via a glass which was made conductive by vapor-depositing tin anhydride.

To close the circuit, after passing through the load the electrons return to the cell via a counterelectrode which also consists of conductive glass. There, the electrons regenerate the dye using dissolved iodine particles. Under direct sunlight, each dye molecule goes through this cycle 20 times per second—the molecular machine runs at 1200 revolutions per minute.

FACTORY AUTOMATION, ROBOTICS

France: Engineering Conference Shows Latest Manufacturing Techniques

92WS0608A Paris TECHNIQUES ET EQUIPEMENTS DE PRODUCTION in French May 92 pp 58-61

[Article by Anne Lombard: "Eight Techniques To Change Manufacturing"; first paragraph is TECHNIQUES ET EQUIPEMENTS DE PRODUCTION lead]

[Text] Whatever the developing machining technique—CO_2 laser, abrasive water jet, high-speed, or nonconventional—the 1992 Congress of the Belfort ENI [National Engineers School] summed up the state of the art.

The topic of this year's Congress of the Belfort National Engineers' School was state-of-the-art techniques in machining and cutting. Presentations by a number of major consumers, suppliers, and subcontractors attempted to compare water jet, laser beam, plasma beam, electrochemical, electric discharge, and ultrasonic machining techniques.

High-Speed Machining

The conference opened with high-speed machining. CETIM [Mechanical Industries Technical Center] is involved in high-speed milling, which calls for the highest performance materials. It was represented by Marcel Palleau, who reaffirmed the advantages of this technology for the roughing and finishing of steel. Tests conducted by Jean Saint-Chely at CETIM have shown CBN [cubic boron nitride] to be unbeatable: 10 minutes at 800 m/min on 35 CD4 grade steel. "This technique is encouraging for the machining of molds, which have a very long chipping time," Marcel Palleau said. For lamellar graphite cast iron, industrialization of high-speed milling will probably begin with the finishing and light (2 to 3 mm) roughing of lamellar graphite cast iron using CBN and silicon-nitride-based ceramics. CBN shows no wear after 30 minutes of roughing of lamellar graphite cast iron at 2,200 m/min (compared to an average life of 20 minutes at 1,400 m/min for silicon-nitride-based tools). "The use of cubic boron nitride multiplies by a factor of 10 the number of workpieces processed by the same tool," according to Jean Saint-Chely.

Daniel Marchand, a research and development engineer at Dassault Aviation, presented its experiences with the machining of light-weight alloys at high spindle speeds. He emphasized that "VHSM [very high-speed machining] should not be used for everything. If a workpiece can be machined with a big cutter on a high-power machine, VHSM will not help."

Water Jet, Laser Beam, or Plasma Beam?

High-pressure water jet (with or without abrasive), electric discharge, plasma beam, CO_2 laser—which is the best choice for cutting? Two remarkable GEC Alsthom and Aerospatiale applications illustrate these techniques, said to be competing, although no one said how.

Until 1986, GEC Alsthom Belfort used electric discharge machining to sink cavities in 13 percent chromium stainless steel ferrules varying in thickness from 6 to 17 mm. The operation took 45 minutes per cavity. Several types of alternative machining were considered: plasma beam, laser beam, and water jet. Plasma beam causes thermal deformation and produces considerable taper. Laser beam cannot handle the material or the thickness. That left water jet, but there was no existing example of industrial use. GEC Alsthom, working with Rouchaud, took the risk of creating the first four-axis abrasive water jet cutting machine in Europe (1987). It paid off. Today, a cavity can be cut in 3 minutes. A second machine, also designed in cooperation with Rouchaud, was purchased in August 1989. It has five axes and a Flow System Paser II cutting head.

But potential users beware! Handling the water jet is not so simple. Bernard Wurz, a welding engineer at GEC Alsthom Belfort issued the following warning: "The manufacturer- or user-specified cutting parameters must be handled with care and caution. The best way to determine the limits of your installation remains experimentation." Still, a few basic parameters—the thickness, the nature of the stock to be cut, the impact of the abrasive—provide a point of departure. The cutting speed depends on the desired quality. "The ratio with respect to cutting speed can be 1:3 if you are judging by the surface finish of the cut and 1:10 if you are looking at the taper." Three-dimensional (3D) cutting (one of GEC Alsthom's machines has five axes) presents jet centering problems. Bernard Wurz's advice is to deal with these problems upstream, during machine design. In the area of composites, Aerospatiale has chosen abrasive water jet machining for its flexible finishing shop. Its Pilot Composites Shop (ACP) has developed a six-axis gantry robot. (Note: This shop is devoted to the processing of stratified or preimpregnated thermosetting or thermoplastic parts.) Aerospatiale uses water jet for the trimming and finishing of stiffeners instead of conventional

cutting tools. Four qualities encouraged it to do so, according to Stephane Frenois, of the industrialization research department, and Christophe Not, a metals processing engineer: "Flexibility of use, ease of integration into the cutting unit on a robot, versatility (composites, metals, and ceramics), and cutting quality (unlike CO_2 laser, there is no heating)." These are supplemented by other typical qualities: the small diameter of the jet (which means that little material is wasted), the ease of cutting (useful with flexible workpieces), and the constant renewal of the jet (the tool does not get dirty).

Lasercav, Excimer Laser

Unlike laser's cutting, welding, and heat treatment applications, its material removal application is not very well known. The Lasercav process, invented by Maho (German manufacturer of milling machines), was also represented at the conference. This process uses CO_2 laser and is a close cousin of electric discharge. It works on the following principle. The laser is focused on the workpiece to be machined. The beam heats the material to the point of sublimation or fusion. The particles are evacuated by gas jet. According to Pierre Lechervy, chief of special machining development at SNECMA, it differs from EDM [electric discharge machining] essentially in that it "is not bound by the electrical conductivity of the material." Convinced of the advantage of this process for aeronautical materials (which are hard to machine and subject to particularly demanding use conditions), SNECMA ran tests on nickel- and titanium-based materials using Taguchi's House of Quality. "The parameters for CO_2 laser machining of such dissimilar materials are themselves very similar. This process will therefore make it possible to perform four types of machining on the same installation: gas-assisted cutting, point fusion machining of metals, heat or surface treatment, and welding work. This is a flexible, versatile production machine." Maho, in any case, considers the product appropriate for the machining of metal pockets in filigree structures, graphite electrodes, very hard materials such as ceramics, and difficult geometric shapes. Other applications include texturing tools and micromachining.

Excimer laser, which emits in the ultraviolet range (at the other end of the visible spectrum from CO_2 or YAG laser), is another form of laser that is suited to micromachining. According to David Damiani, chief of excimer laser applications at ILP, it has a promising future in high-precision machining. Unlike CO_2 laser, excimer laser is a high-pressure, short-wave, and wide-beam. It does not produce a heat-affected zone. This aspect is of interest for the machining of thin sheets by photoetching in the microelectronics and microwave industries. Excimer laser can also perform micromachining by light-sensitive resin etching (PMMA [polymethyl methacrylate]), used in microelectronics.

Electrochemical, Ultrasonic Machining

Electrochemical or electric discharge machining—which is the best choice? They resemble each other in that both cut the shape of an electrode in the material to be machined, and both are often used in place of milling for mold parts or forging dyes. There are two reasons for this: the excellent surface finish obtained and the ability to machine very hard materials. Heat-treated steels can be machined, and finishing operations are eliminated. According to Marc Michaud, commercial manager at Dubuis, electrochemical machining of a Z 38 CDV 05 steel connecting rod takes 40 minutes including setup time, while the same operations takes six hours and 30 minutes with electric discharge and 11 hours with copy milling. Luigi Bianchi, chief of metallurgy at Automobiles Peugeot, presented a comparison of the two types of machining for short- and medium-length runs of Z 38 CDV 05 treated steel dyes. The two processes were chosen on the basis of the complexity and/or size of the workpiece. For short runs, electric discharge was chosen for large dyes with complex shapes and electrochemical, for small dyes with simple shapes. For medium-length runs, electric discharge was chosen for large dyes with complex shapes and electrochemical, for large dyes with simple shapes or small dyes with complex shapes. Briefly, comparison of the machining parameters shows that nonoptimized electrochemical machining produces significant overcut, consumes more electricity, requires higher liquid feed rates and pressure, results in irregular underdimensioning, and demands more delicate irrigation. On the other hand, surface finishes are equal throughout machining, the electrode does not wear out, only one is needed (compared to the usual two with electric discharge), and it takes 15 minutes for one workpiece compared to six hours with electric discharge (Automobiles Peugeot's cost comparison: 1,920 French francs [Fr] versus Fr300 for electrochemical machining). And, with one electrode, the precision is the same (between 0.05 mm and 0.10 mm). However, with two, electric discharge precision goes to 0.02 mm.

Luigi Bianchi said in conclusion, "we only make electrochemical-type electrodes if the shape of the cut will not change because, although the cost of the electrodes is the same for the two techniques, it is much more expensive to change the shape with electrochemical machining (electrolyte gaps and copper versus graphite with electric discharge). The latest of the nonconventional methods, ultrasonic machining (20 or 40 kHz) is the equivalent of electric discharge for nonconducting materials and very fragile, very porous materials.

Surface finishes vary from 2.5 microns Ra [surface roughness] for graphite to 0.8 micron for silicon nitride with 50 micromicron boron carbide grains. With shaping, machining precision depends on the machining precision and state of wear of the sonotrode.

With very fragile and/or very porous materials, very rapid material removal rates (several centimeters a minute) are obtained with 1 percent wear on the sonotrode for glass and less than 0.5 percent for graphite. The operation takes several minutes compared to several hours with conventional manufacturing. Restoring worn electrodes takes between 2 and 15 minutes. According to

Maurice Houlot, full professor of mechanical engineering at ENSAM, this "will free the user of electric discharge processes from nonwear constraints."

With harder materials (ceramics, quartz, carbides, nitrides, and precious stones), speed drops and wear increases. Thus ultrasound would appear to be the last resort in machining if the other processes fail. In any event, it is useless on tempered steel or sialon, except to obtain very small perforations or perforations without heat constraints. Generated ultrasonic machining is already in industrial use in the aeronautics industry, where it is used for the manufacture of accelerometers, inertial sensors, oscillators, and resonators.

Dassault Factory for Superplastic Mirage, Rafale Parts

92WS0608C Paris TECHNIQUES ET EQUIPEMENTS DE PRODUCTION in French May 92 p 16

[Article by D.C.: "Mirage 2000 and Rafale Wingtips Made Using SPF/DB"; first paragraph is TECHNIQUES ET EQUIPEMENTS DE PRODUCTION lead]

[Text] After 10 years in development, superplastic forming and diffusion welding have become an industrial reality at Dassault. A fully integrated shop has begun serial production.

"The specific design of the Rafale's mobile leading edge devices led us to develop superplastic forming and diffusion welding (SPF/DB)," says Jean Lafond, director of Dassault's Poitiers establishment. Without this new technique, it would have been impossible for us to make them, at least not with the qualities of lightness and resistance they have now." Although the Rafale is still only at the prototype state, the aircraft builder has perfected the process. Since 1986, over 500 major parts have been fabricated, including serial production of leading edge devices and winglets for the Mirage 2000. "We preferred to test the industrial feasibility of this new technology on pre-existing parts before using it on a new aircraft model," Jean Lafond says.

From a 60 Percent to a 10 Percent Rejection Rate

Implementing the process was not without its problems. The first year, the rejection rate was over 60 percent. It has now stabilized at between 15 percent and 20 percent. The eventual objective is to bring it down to less than 10 percent.

However, these difficulties in implementation have been more than offset by the resulting gains, whether in terms of performance or in terms of parts industrialization. Traditionally, a Mirage 2000 wingtip is an aluminum structure machined from blanks and comprising 76 primary parts held together by 750 fasteners (rivets and bolts). With SPF/DB, this same wingtip contains only 25 titanium parts and 160 fasteners. The 10 percent increase in weight may seem small (titanium does have a density that is twice that of aluminum), but it is explained mostly by the fact that the design of this part was tailored to a pre-existing aircraft. On the Rafale, the increase will be in the neighborhood of 40 percent! Another important characteristic of the part is its aerodynamic perfection, enhanced by the fact that, instead of being riveted, the skin is welded to the structure using the diffusion sheet-welding technique.

From the standpoint of industrialization, superplastic forming considerably reduces the cycle time—on the order of 50 percent. "We save four months on an eight-month cycle," says Alex Deblois, head of the industrial development department. It used to take six companies to make the traditional aluminum structures. Today, everything is done in-house in the same shop."

This shop is a model of its kind with respect to integration. Completely wired, it has a fully computerized assembly line (CAD/CAM [Computer-Aided Design/Computer-Aided Manufacturing], computer-assisted production management, a shop control processor, automatic traceability) and is highly automated.

This very compact (2,500 m^2) shop is designed for flat products with dimensions of up to 3,600 mm x 1,000 mm. The production program is as follows: cutting of sheets and masks on a 1,500 W CO_2 laser machine, chemical machining of thicknesses on a fully automated installation associated with a masking unit, superplastic forming of parts and diffusion welding on two presses with 1,200-metric-ton heated plates, and televised industrial radioscopy control by means of an eight-axis manipulator.

Up to 1,000 Percent Sheet Elongation

The heart of the shop is of course the two heated presses, the oldest of which was developed in-house and the most recent, by ACB [Brittany Workshops and Yards]. The principal behind SPF/DB consists of taking advantage of the ductility of titanium at high temperatures (900°C) which enables elongation of the material by as much as 1,000 percent as well as solid phase atomic diffusion welding. The parts, such as the leading edges of the Mirage 2000, are initially composed of four sheets of titanium, which are transformed into hollow, self-stiffening structures by the combined action of temperature and gas pressure.

The cycle time for this operation is relatively long, lasting almost 13 hours. This is due in particular to the heating time of the sheets, which go into the mold cold, and to their "growth," which must be accomplished at constant speed. In contrast, diffusion welding, which occurs during the same cycle, takes no more than two hours. "Now that we have perfected this technique, we are planning on expanding our offering in order to bring more work into the shop, which represents a total investment of more than 100 million French francs," Alex Deblois says. "We have already contacted foreign

companies in both the aerospace and shipbuilding industries about the forming of titanium sheets, which are very corrosion-resistant." Dassault research indicates that superplastic forming (without diffusion welding) can be used on some 20 different materials, including aluminum. Parts already produced include electronics enclosures and windshield support frames.

LASERS, SENSORS, OPTICS

Max Planck Institute Uses Lasers to Create 3-D Metallic Microstructures

92MI0601 Munich MPG SPIEGEL in German
9 Jun 92 pp 1-4

[Article by Horst Meerman: "The Eiffel Tower Built by Laser"]

[Excerpt] A three-dimensional metal structure created in micrometer scale for the first-time, laser-induced method for the deliberate alteration of material properties.

Using the Laser Chemical Vapor Deposition (LCVD) method, Dr. Michael Stuke and his team of colleagues at the Max Planck Institute of Biophysical Chemistry in Goettingen have succeeded for the first time in creating three-dimensional, unsupported, extremely filigree metallic structures in micrometer scale with laser light. The structures are transferred to detachable substrates by the direct-write method. The Goettingen laser researchers describe this result as a first in basic research, and one with wide-reaching implications for applications—primarily in the fields of microelectronics and microsystems technology.

With this method, a laser beam is focused onto a specimen, e.g. a plastic, and, simultaneously, a metallic compound or a gas mixture is introduced. This decomposes at the laser-heated location of the specimen. The metallic component is precipitated off, and the residue of the reaction products is pumped away. If the specimen is rotated in different directions, different metallic structures are created on the surface of the substrate, e.g. on a polymer. The desired structures can actually be "written" onto the substrate, and this method is therefore also referred to as the "laser direct write method." Using this method for the deliberate alteration of material properties on surfaces, the Max Planck Institute researchers in the Department of Laser Physics led by Professor Fritz Peter Schafer have now produced a three-dimensional structure—a type of Eiffel tower—a tiny creation, scarcely bigger than the head of a match.

According to Dr. Stuke, the properties of materials can be deliberately influenced by excitation with energy-rich radiation. Layers and layer systems, often well-defined, are formed as a result. Their laser-induced production, characterization, structuring, and modification have opened up a wealth of new opportunities in research and application. If a laser is beamed at a surface, a deliberate change will be induced only in certain cases. A red adjusting laser beam, for instance, will induce no significant permanent change on a surface in contact with air, but, given a suitable wavelength and, more particularly, intensity of the laser, and with the right environment for the surface, the latter can certainly be deliberately modified. According to Dr. Stuke: The potentially reactive environment of the surface can be a gas or gas mixture that is in contact with the surface. In this case, the radiation excitation has to take place through a window or a pump stage, so that only the desired gas surrounds the surface. The reactive environment can also be in condensed form, either as a liquid or as a solid film, which is applied evenly by freezing out or spinning on."

This had the advantage, continued Dr. Stuke, that the reactive materials were located only where they were needed, and had no contact with, for example, optical components, which could have the effect of considerably increasing the life of the reactive materials. In some cases, it was possible to achieve the desired changes to the surface by direct interaction between the energy-rich radiation and the material. The energy did not always have to be excited in the form of optical radiation. Energy-rich neutral or charged particles like electrons or ions were also very amenable to focusing, and could therefore—as in lithography—generate very small structures, but the advantage of light or laser light lay in the fact that, even through a dense environment—typically with a density of 10^{23} molecules per cm^3—energy could be excited with precise definition in terms of space and time, without distortion or uncontrolled attenuation of the laser beam. The reactive environment, said Dr. Stuke, could be a corrosive gas, such as chlorine, in which case the material was eroded under suitable conditions, but it could also be oxygen, in which case oxidation would occur.

Organometallic compounds play an important part in the precipitation of thin layers onto surfaces. What conditions must this type of compound, which is to dissociate when energy is applied, fulfill? It must be storable, stable, and sufficiently volatile to travel without decomposing and with adequate density to the locations where it is required to decompose. "There it should dissociate when energy—heat, light, laser light, or particles—is supplied, releasing the metallic component or the species that we wish to precipitate out, while the stable and volatile residue separates out from the specimen." If the residue were not stable, but reactive, the compound would continue to react with the layer, thereby destroying the layer properties.

These were, stressed Dr. Stuke, actually very simple conditions, but in practice they were all fulfilled only in very rare cases. In particular, the residues were often reactive. One compound that fulfilled all the conditions was that of aluminium trihydride with trimethyl amine. It dissociated when supplied with energy, releasing the stable trimethyl amine groups and hydrogen, while aluminium precipitated onto the specimen with good purity. The compound was stable at room temperature, and dissociated at approximately 100°C. "This means that even thermally sensitive materials such as polymers are suitable as substrates. Our experiments have shown that aluminium can be written directly onto a surface, in our case, a polymer, just as you would with a pencil. The only difference is that we are using a laser beam."

As Dr. Stuke added, the laser direct write method is an important process for microelectronics applications. His team is in contact with industry, for example is a joint project, sponsored by the Federal Ministry for Research and Technology, between the Max Planck Institute for Biophysical Chemistry [MPI] and three large companies in the microelectronics field. A further project is participation in the superordinate association "Materials Processing With Excimer Lasers," in which the MPI group is dealing with the section on "Ablation (stripping) With Ultra-Short Excimer Lasers, Mechanisms and Consequences for Applications."

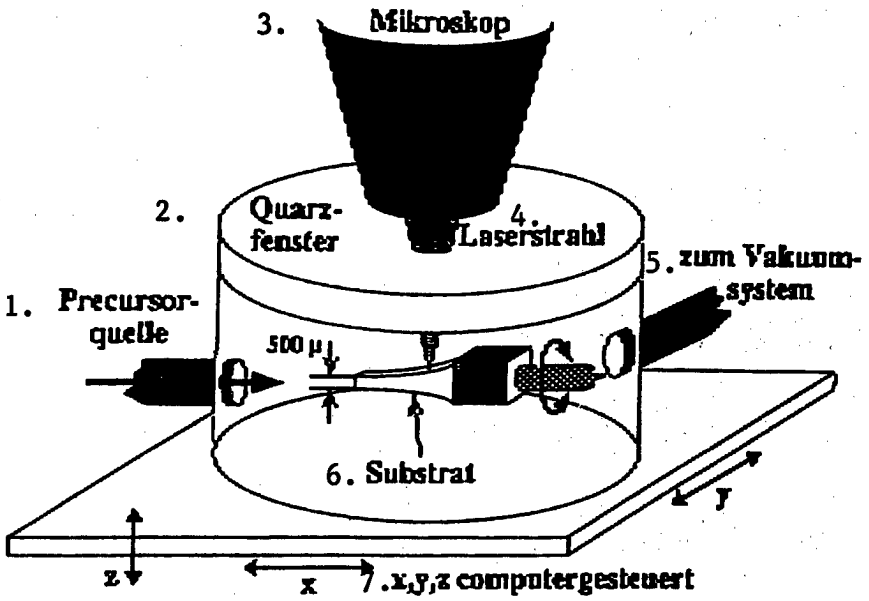
With the laser direct write method, metals can be directly deposited not just onto flat substrates, but also onto three-dimensional ones. It is therefore the research aim of the Goettingen group to produce small, three-dimensional, unsupported structures with this method. "This means that we have to find a substrate that is suitable for precipitation, but that can also be re-dissolved, and that behaves in such a way during the dissolution process that no stresses or cracks that would immediately rupture these filigree structures can occur." In the experiment, a laser beam is focused onto the substrate. The specimen is slightly heated locally, and the gas mixture decomposes. "By moving the specimen in various directions and around an axis, we can reach every point, and thereby precipitate a three-dimensional structure—in this case, an aluminium structure onto a polycarbonate substrate."

Although the products created are predominantly stable, hot molecules are sometimes formed during dissociation, and these affect the surface of the polycarbonate in such a way that the outermost skin is difficult to detach. Dr. Stuke says: "This means that, although we can detach the entire substrate, a type of skin remains between the aluminium struts—just like a duck's webbed foot. We sever this skin by UV Excimer laser ablation (stripping) before the dissolution process and without damaging the metal."

However, the tiny structures are extremely labile. The surface tension of water is sufficient to tear the construction apart. The laser researcher commented: "In preliminary experiments, we immersed these filigree structures in water, whereupon they broke apart. If we added a detergent to the water to decrease the surface tension, the structure remained intact."

Dr. Stuke commented on the results of the experiment: "This is the outcome of basic research. We have been able to show for the first time that it is possible to create a three-dimensional, unsupported, metallic structure with laser light—something that has never been done before." The researcher considers that possible applications are in the construction of microsensors or microreactors that are suitable as acoustic sensors or flow meters. In addition, there is already interest from the field of high frequency technology, where the aim is to design a microwave resonator using the method developed by the Goettingen researchers. Also, "I can well imagine that deposition will be applied not just to metals, but also to semiconductors, supra conductors and ceramics, so that it may be possible in the long term for any material whatsoever to be precipitated three-dimensionally on a micrometer scale or even below, with spatial dissolution." Under software control, it should be possible to produce complete prototypes right down into the sub-micrometer range with this method.

Schematic Diagram of the experiment setup. A laser beam is focused by a microscope lens through a window



Key: 1. Precursor source 2. Quartz window 3. Microscope 4. Laser beam 5. To vacuum system 6. Substrate 7. x,y,z computer controlled

onto the surface of the specimen located in the reaction chamber. At the focal point of the laser beam, the specimen is immediately heated up by approximately 100°C, as a result of which the aluminium-containing gas flowing past this location decomposes locally on the surface, depositing out aluminium. By rotating the specimen around an axis or moving the specimen table in xyz direction, every point of the specimen can be reached with the laser beam. After deposition of the aluminium structure, the substrate is dissolved in a suitable solvent. The unsupported, three-dimensional, filigree metallic structure generated by the laser direct write method remains behind.

France: Fiber Optic Materials Development Applications

92WS0657 Paris INDUSTRIES ET TECHNIQUES in French 8 May 92 pp 26-27

[Article by Michel Le Toullec: "A Rennes Laboratory at the Leading Edge of Research: Fiberoptic Materials"—first paragraph is INDUSTRIES ET TECHNIQUES introduction]

[Text] Fluorine glass and tellurium glass open new applications for fiber optics in telecommunications, surgery, thermal imagery, and remote spectrometry.

Optical fiber still has some surprises in store for us. It already enabled us to chat on the telephone with other continents. Soon, it will replace scalpels in certain surgical operations, monitor the temperature of premises, or perform remote-spectrometrical analyses. In fact, new glass families capable of yielding optical fiber with novel properties, in particular in the infrared spectrum, are paving the way to new applications.

In this field, the most inventive and most productive research group is undoubtedly Professor Jacques Lucas's team. In fact, it was at the inorganic chemistry laboratory of the Rennes faculty of sciences, in 1973, that fluorine glass saw the day—by accident. And that team is the one that has made the largest contribution to the development of these promising materials.

The interest of fluorine glass is twofold. First, it can carry a surprisingly wide range of infrared radiations. "Where oxide glass will transmit wavelengths from the near ultraviolet (0.2 microns) up to 2 microns into the infrared," Jacques Lucas explained, "fluorine glass will reach about 7 microns. Then, fluorine glass proves a lot more transparent. Optical losses—which always attenuate light as it goes through a fiber—are therefore smaller: less than 0.01 decibel per kilometer [dB/km], in theory, for a fluorine glass fiber, compared with 0.2 for silica. Being much less attenuated, the light signal can therefore be carried over much longer distances."

Soon, the laboratory geared its research to telecommunication-related applications. Other research centers specialized in this field followed suit: the CNET [National Center for Telecommunications Studies] in Lannion, the research centers of Alcatel-Alsthom (in Marcoussis), NTT and British Telecom, and those of several American laboratories. Actually, the characteristics of fluorine glass are such that it might conceivably transmit a signal via optical fiber over 1,500, or even 2,000 km, with no need for repeaters (the devices included in current networks every 100 km or so, to amplify the signal).

Research led to the selection of a number of glass types especially well suited for that kind of use: Zblan (i.e. zirconium, barium, lanthanum, aluminum, and sodium fluoride), Bizyt (barium, indium, zinc, yttrium, and thorium fluoride), and the latest, the Bigazyt (same as before with an addition of gallium fluoride). The Rennes laboratory then added production of the fiber itself to its program. The result is a controlled-atmosphere fiber-making tower that has been operational for less than one year.

But a major problem remains to be solved before going on to industrial applications: fiber performance characteristics with respect to attenuation are still far from their theoretical level. Instead of the 0.01 dB/km expected at 2.5 microns, the Americans report 0.6 dB/km on a fiber 110 meters [m] long (the best result to date), the Japanese 0.7 dB/km over 30 m, the British 3 dB/km over 200 m, and the CNET 14 dB/km over 200 m. The most likely culprits for this performance drop are minuscule bubbles or microcrystals that diffuse or diffract the light, as well as impurities (transition metals, rare earths) that absorb some of it. Research on the production of ultrapure glass by chemical vapor deposition (CVD)—a process already used for silica fiber—was then performed, in particular at Corning. But without much success.

Hence the interest of recent research performed at the CEREM, the Materials Study and Research Center of the CEA [Atomic Energy Commission]. In order to avoid impurities resulting from the contact between the molten glass and its crucible, the group simply proposed to do without a crucible. With gaseous lift (a process developed jointly with Alcatel Alsthom), the glass levitates over a cushion of hot gas coming out of a porous graphite membrane. It never comes into contact with any crucible, from the raw-material powder-mix stage to completed cooling. The samples obtained contain 100 times, sometimes even 1,000 times fewer defects by volume than the best materials achieved before. The process could be used to produce directly preforms weighing several hundreds of grams.

Meanwhile, and especially since the end of the eighties, researchers have explored a new path. It consists in using fibers that are shorter, and therefore less susceptible to impurity problems. Especially for making optical amplifiers, as an alternative to the current electronic repeaters. In this field, this is one of the most recent research themes of the CNET at Lannion. "With a praseodymium-doped core, the fiber can be used to amplify, by

laser effect, the optical signal transmitted via a silica fiber," Jean-Luc Adam, a researcher at the Rennes laboratory, indicated.

Remote spectroscopy might also make a leap forward thanks to this fluorine glass fiber. The advantage would be the possibility of making chemical analyses anywhere, especially on a production line. Once detected, the signal characteristic of a given organic molecule (hydrocarbon, carbon oxide) would travel over several tens of meters to the spectrometer. The principle is rather simple, but until now it was not feasible. That is because the vibrations of carbon-hydrogen or carbon-oxygen bonds (around 4.2 and 3.4 microns respectively) lie outside the silica transmission window.

Other researchers have also attempted to push still further the infrared transmission limit. The goal was to transmit the CO_2 power laser which transmits at 10.6 microns, a wavelength at which fluorine glass, and a fortiori silica, are opaque. During the seventies, this research yielded chlorine glass (based on bismuth and potassium chlorides, transmitting up to 14 microns) and chalcogen glass (arsenic or germanium sulfide or selenide, which are transparent up to 11 microns). But the former proved unstable in air. And the latter, marketed by Morton in the United States for the past two years, is not very attractive because it presents a toxic hazard.

That was reckoning without Professor Jacques Lucas's laboratory! Actually, in 1986, his team produced a glass based on halogen (chlorine, bromine, iodine) telluride, and sulfur or selenium, which led to a new family of materials, the "TeX Glasses." "Very stable when in contact with air or water, they do not present any particular toxicity problem, and they transmit in the infrared up to about 20 microns, with an ultratransparency domain between 8 and 12 microns," Xian Hua Zhang, the Rennes researcher who initiated the research, indicated. "The lowest optical-loss level reached was 200 dB/km at 9 microns." Also, contrary to fluor glass, this glass shows little tendency (or none at all) to crystallize. One less thing to worry about when making the glass or heating a preform to draw the fiber. The Rennes group finally solved one of the major problems of these glass types: their poor heat resistance. This has further expanded their potential applications. First, CO_2-laser transmission for industrial or medical applications. Thermal imagery is also being considered, in particular, to detect the infrared radiations emitted by heated objects. Such optical sensors might detect an abnormal temperature rise, or a fire, with greater sensitivity than a thermocouple system. Thomson and Matra Defense are interested in using it to detect the wavelengths emitted by the human body (around 10-12 microns). The goal is to develop new night-vision systems, which have obvious military applications but might also interest all security professionals. These are niches with a nearly guaranteed commercial future!

German Institute Uses Laser for Microstructures

92WS0682C Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 24 Jun 92 p 8

[Unattributed article: "Match-Size Eiffel Tower—Max-Planck Institute Invents Direct-Write Technology for Microstructures"]

[Text] At the Max-Planck Institute for Biophysical Chemistry (Professor Fritz Peter Schaefer) in Goettingen a new method for the production of three-dimensional micrometer-size structures has been invented. Dr. Michael Stuke and his staff are using laser light to obtain specific changes in the material properties on the surface of a suitable substrate. The structures are transferred to the substrate using a direct-write method. Subsequently, the substrate is dissolved and releases the structure which was formed.

This method developed by the Max-Planck Institute is still a basic research result. However, it is quite possible that in the foreseeable future it will be used for the production of microsensors and actuators which can serve as acoustical sensors or flowmeters, Stuke hopes. It is conceivable that in addition to metal, also semiconductors, superconductors and ceramics could be separated so that in the long term it might be possible to separate any three-dimensional material in the micrometer range or less using spatial dissolution. According to Horst Meerman (MPG SPIEGEL 3/92) this method focuses a laser beam on the substrate. Simultaneously, a metal compound or a gas mixture is used which breaks down at the site which is heated by the laser beam. The metal portion is separated, and the remaining reaction products which are generated are pumped off. When the substrate is turned in various directions, different metal structures are generated on the substrate surface. The desired structures can actually be "written" on the substrate. The material properties can be modified very specifically by incorporating high-energy beams. This frequently leads to the formation of well-defined layers and layer systems. According to Stuke, the fact that they are generated, characterized, structured and modified by laser has led to many new research and application possibilities.

For the tests, a mixture of aluminum trihydride and trimethylamine was used. When energy is added it breaks down releasing the stable trimethylamine groups and hydrogen, while aluminum with good purity precipitates onto the substrate. The compound is stable at room temperature and breaks down at approximately 100°C. However, the minute structures are very labile. To free them, substrates have to be found which are suitable for precipitation and which can be dissolved again without causing stress and cracks.

The direct-write method will probably become the second major method of microstructure technology. Years ago, the photolithographic Liga method had been developed. With this method, minute functional parts

with vertical walls can be produced which resemble punched out parts. With the direct-write method the parts can be given any shape in all three dimensions.

MICROELECTRONICS

Subsidies for German Microchip Production Called Unnecessary

92WS0558A Hamburg DEUTSCHES ALLGEMEINES SONNTAGSBLATT in German 8 May 92 p 10

[Text]

Expensive Lesson

The European economy feels dependent on Japanese microchips. It demands heavy subsidies for its own semiconductor development. But the fear of East Asian high technology is unfounded.

Along with microchips in general and memory chips in particular, there are now also Eurochips. Or more precisely: There should be—that, at least, is what a number of industrial representatives want who, in recent months, came forward with increasingly vocal calls for subsidies for European semiconductor production, forced up against the wall by Japanese and American competition. Under no circumstances, it is said, could an industrial nation of Germany's standing get along without access to chip production technology.

The most prominent representative of this demand is Heinrich von Pierer, future chairman of the board of Siemens AG. At the Hannover Trade Fair in April, he used strong words to take policy to task. "It is necessary to reconsider the principle of liberalism and free economy if the continued development of microelectronics in Germany is at stake." That means: Government should finance completely or at least in large part the construction of a factory for the next generation of memory chips. The cost would be at least 1 billion German marks [DM], perhaps even DM2 billion. A supporting argument has already been found: The site for the new production plant should be Dresden.

Advocates of the Eurochip do not accept the objection that the Japanese and Americans will be certain to put these memory components on the market faster and more economically. Some warn that the Japanese will take advantage of their market-controlling position in order to get a stranglehold on their European clients and competitors. Others fear that by awarding production of application-specific integrated circuits (ASICs) to Japan, clients' valuable systems information contained in these circuits could also flow to East Asia—with possibly disastrous consequences for the position of German industry in the international market.

The validity of these arguments is contested. After all, Japan's chip industry, which is now suffering from declining profits, also lives from the sale of its products—and not from the fact that it holds them back for strategic reasons. And a manufacturer of ASICs who abuses the systems knowledge entrusted to him by his clients could hardly remain for long in the market.

The research ministry in Bonn emphasizes another aspect. Chips are not just key components for many products: On the contrary, the technology necessary for manufacturing highly integrated circuits is itself a key technology, and it has a decisive influence on the capabilities of a highly developed economy. Whoever does not master them not only abandons the manufacture of components, which can simply be purchased elsewhere on the world market; he also abandons the expansion of the accompanying infrastructure in qualification, research, development, and production—and with it access to the know-how which allows optimal utilization of these components.

What is the Nationality of a Silicon Chip?

Both lines of argument lead to the same conclusion. The safeguarding of an independent German, or at least European, chip production appears to be a task of the greatest importance for industrial policy. And because they also see it that way, European countries and the EC have already invested billions of marks in building up an independent potential for chip production in recent years. If industry now makes further demands in this direction, it seems reasonable to first examine critically the results of these industrial policy efforts achieved thus far. There is sufficient cause to do so.

Almost 10 years ago, Siemens of Germany and Philips of the Netherlands launched their so-called Megaproject, to the accompaniment of a great stir in the media; it was to lead to the production of the one megabit chip by 1987. Bonn and The Hague supported the project with half a billion marks, one-third of the total volume. The first megachips "made in Germany" were not delivered in 1987, however, but with a one-year delay, and then the quicker Japanese had long had the market under their wings. Furthermore, the megachips, produced in Regensburg, were not nearly as European as the project's creators had promised. The Siemens researchers had had difficulties during preparation for production and were only able to begin manufacturing after they had purchased the basic technical processes from Japanese competitors.

The Munich team also introduced the four megabit chip considerably later than the Japanese, and that with such an unfavorable profit to loss ratio that rumor has it that production never advanced beyond the pilot stage. Frustrated, Philips finally announced that it would withdraw from cooperation. Things went no better with the 16 megabit chip. Last June Siemens threw in the towel and announced the conclusion of a cooperation agreement with IBM: Starting immediately, the 16 MB chip would be produced jointly with the Americans, and development work for the 64 MB chip would also proceed cooperatively.

Of course, the lovely word cooperation should mislead no one concerning the true nature of the agreement. With the 16 MB chip, Siemens completely abandoned the design which they had developed on their own and simply bought their way into IBM for a great deal of money. Incidentally, the Americans, with their multinational approach, produce the 16 MB chips for Siemens in a plant in France—it was most convenient to set up there.

Whether the plants for the new chip are located in the U.S., in France, in Dresden or in Sindelfingen, what goes on behind factory doors will have very little to do with German or European technology. The nationality of electronic components is a bit of a problem, anyway. To date, no one has clarified what is actually meant by "national" or "European" access to chip technology. Three years ago, when German Chancellor Helmut Kohl ceremoniously started up the production line of the state-of-the-art four megabit chip in IBM's Sindelfingen plant, he may have reached for a rather symbolic push-button switch, but the chips, which were baked in the Swabian plant, never made it to the German market or any other national market; they were intended exclusively for company use. The processes by which the Sindelfingen chips are made belong neither to Germany nor to Europe, but rather to the internationally active IBM—and it, too, purchases in Japan what it cannot get elsewhere.

Siemens's purchase of IBM technology for the 16 MB and 64 MB chips meant recognition of the fact that the development of leading-edge technology is far easier with international cooperation than in a national framework. Logically, this decision also meant the end for the central part of the JESSI project, created with great hopes in 1989. The "Joint European Submicron Silicon Initiative" set itself the goal of bringing the 16 MB chip to production readiness by 1993 and the 64 MB chip by 1996 as products of independent European development.

Nothing has come of it. In the JESSI initiative's "new profile" presented at the end of last year, the superchip, formerly proclaimed as a leading-edge technology, was mentioned only in passing. With successful cooperation between Siemens and IBM in this area, "there is no longer a need for public support."

Incidentally, JESSI and research minister Heinz Riesenhuber (CDU) have gained the insight "that Europe cannot fully cover all the areas relevant for microelectronics on its own, but rather must seek international cooperation." With European governments and the EC having invested roughly DM4 billion in the project thus far, this was an expensive lesson.

Siemens's Future in Microchip Production Discussed

92WS0606B Munich SUEDDEUTSCHE ZEITUNG in German, 4 Jun 92 p 46

[Interview of Professor Dr.Anton Heuberger, Director of the Fraunhofer Institute for Microstructure Technology, Berlin, by Martin Urban, SUEDDEUTSCHE ZEITUNG]

[Text]

SZ (Sueddeutsche Zeitung): Siemens has announced the cancellation of its cooperation with IBM on the 64-megabit chip. Is it important that the chip of the next generation, the 64-megabit chip, should be made in Germany?

Heuberger: As far as I know, the cooperation with IBM will be continued, as was agreed, until the first 64-megabit memory chip is produced—but no further.

SZ: In other words they no longer wish to produce the chip cooperatively.

Heuberger: Apparently Siemens no longer wishes to be active in the production of memory chips. Purely economic reasons argue in favour of this, primarily the decline in prices.

SZ: I repeat my earlier question: Is it important that a chip of this type should be made in Germany?

Heuberger: Yes, very important for the overall German economy. It is even more important, however, that as the next step we do not also give up user-specific circuits of the very high scale integration level.

SZ: The technology of tomorrow will be microsystems, the connection of microchips to microsensors and micromechanics. For these purposes does one need such a high-performance memory as the 64-megabit chip?

Heuberger: Naturally in the initial phase of such microsystems we will not be able to integrate the most extreme structural refinements or the highest integration densities with new functions, in order to make complex silicon systems. But for the medium-term we will also need higher integration densities in microsystems.

SZ: For the user the user-specific integrated circuits, the ASICs, are the important thing. Are we already looking here at the new generation of 64-megabit chips, or is it still too early for this?

Heuberger: The bulk of the ASICs will not need this technology of very high scale integration, which is powered each time by the development of memories, until much later. This does not apply, however, to the growing demand for advanced, superior-quality ASICs. A chip for HDTV [high-definition television] is, for example, such an ASIC. Here we will very soon require the highest levels of complexity.

SZ: Although they are learning only with the 1-megabit memory that the application of a product doesn't come as quickly as originally anticipated.

Heuberger: The brutal timetable of one generation succeeding another every three years clearly can't be sustained either technically, financially, or economically, even in Japan. I see on the whole a slowing-down.

SZ: When do you expect the first commercial 64-megabit chip?

Heuberger: By the mid-90s in Japan, where it will be produced on a large scale.

SZ: There is talk already about the generation after the next—the 256-megabit chip. Do you see any technical developments—and here I am thinking particularly about microsystems—which would make this useful?

Heuberger: We will need this integration density in data storage as well as in logical circuits. Perhaps in all applications of fast recognition of picture patterns, speech patterns, or in the analysis of very complex chemical spectra.

SZ: In other words also in mass markets. Picture pattern recognition will also be of interest for automobiles.

Heuberger: Exactly so. If, for instance, you want to have an accident-proof automobile on the highways, then this can only come about through very fast and complex picture recognition. It is questionable though whether this will be possible even with the integration densities of 64- or 256-megabit memories.

SZ: The 64-megabit memory basically can still get by with light-beam lithography, if it is a question of the etching of structures into the base material, silicon. With the 256-megabit memory wouldn't one have to work with the shorter-wave X-rays?

Heuberger: X-ray lithography has procedural advantages. In my view this means, when the technical and economic arguments are evaluated, that it is urgent that the 256-megabit memory be produced through X-ray lithography. To return again to your initial question—in my view we need in Germany not so much memory technology itself, but we need a rational industrial base in order to be able to develop advanced logical circuits and user-specific technologies as far as microsystems. It is unbelievably important that a political consensus should be found for this. Even the further development of ASIC technologies cannot be managed by Siemens alone as a basis for all of Germany. For this reason we must continue to seek an agreement betwen the most important industrial enterprises and the political level, in order to define semiconductor technology as a common task. Otherwise I see great harm befalling our national economy, since silicon technology for ASICs and microsystems is the foundation for the still extensive system industry in Germany.

NUCLEAR R&D

Karlsruhe Research Center Develops Robot Arm for Nuclear Power Station Maintenance

92MI0635 Bonn DIE WELT in German 9 Jul 92 p 7

[Article by Frank Surholt: "Powerful Robot Arm Services Nuclear Reactor"]

[Text] The prototype of a maintenance manipulator for the planned European nuclear fusion reactor has gone into operation at the Karlsruhe Nuclear Research Center. The computer-controlled robot arm is called Edith, an abbreviation for "experimental device for in-torus handling." The 10-meter arm is to be used for future maintenance work inside the reactor, and has been developed over five years at a cost of 6 million German marks [DM].

The robot arm is manipulated by a worker whose hand is inside the computer sleeve; the movements of the mechanical arm, comprising four joints, correspond to those of the human operator. The device accesses the entire interior of the reactor through two openings in its outer wall. Edith can also move fragile objects by means of interchangeable tongs. The device weighs up to four tonnes and is shortly to be used in a vacuum at a temperature of 150°, while subjected to extremely high radiation.

HERA Project Gets Green Light for Quark Structure Analysis

92WS0699A Duesseldorf VDI NACHRICHTEN in German 12 Jul 92 p 22

[Unattributed article: "First 'Light' in the Super Electron Microscope: Collision of Protons and Electrons Delivered Data"; first two paragraphs are VDI NACHRICHTEN introduction]

[Text] Hamburg, 12 Jun (VDI-N)—HERA [Hadron Electron Ring System] begins research: The only accelerator in the world in which two different types of particles collide.

The "starting gun" for the physics experiments in the new HERA storage ring sounded last week. For the first time, it was possible for both HERA experiments H1 and Zeus to collect measurement data on proton-electron collisions. Thus begins the HERA research project which will last at least 10 years with high-energy proton and electron particle beams. The physicists hope to gain new understanding in the exploration of the microcosmos, the search for the smallest constituents of matter and the forces that hold them together.

Construction of the two detection devices H1 and Zeus began in early 1988 along with the experiment halls seven stories down and ended a few weeks ago with the moving of the 3,000-metric-ton device into HERA's collision zone. The vacuum tube in which the particles circulate in HERA was passed through the interior of H1 and Zeus so that the particle collisions take place in the center of the detection devices. The two experiments were able to begin measurements immediately when HERA delivered collisions of protons at the planned energy of 820 billion electronvolts (BeV) and of electrons at 27 BeV.

With HERA—currently the largest research instrument in Germany—it is possible to investigate the composition of matter 10 times more accurately than ever before.

The particle accelerator acts as a super electron microscope with which the inside of the protons is "magnified." With the high impact energies in HERA, many new particles are generated with each collision. They leave behind "tracks" which are electronically recorded by the two 10 x 10 x 20 meter detection devices H1 and Zeus. In the evaluation of the measurement data, "images" emerge from which the physicists obtain information about the type and characteristics of the constituents of the proton as well as the interactions taking place between them. The Hadron Electron Ring System [HERA] is the first and only storage ring in the world in which electrons and protons (they belong to the group of particles known as "hadrons") collide at high energies. Thus dimensions are investigated that are smaller than a millionth of a millionth of a centimeter—dimensions which are 10,000 times smaller than the smallest atomic nucleus: the nucleus of a hydrogen atom consisting of one proton.

HERA is opening new possibilities for the physicists through so-called "deep inelastic scattering." In prior experiments of this type, it was possible only to scatter accelerated electrons on a matter sample and thus to study constituents of matter of the magnitude of atomic nuclei, protons, or neutrons for their structure. In HERA, highly accelerated electrons collide with highly accelerated protons flying toward them, which results in such large transfers of pulses that this is referred to as "deep inelastic scattering." The electron penetrates into the proton and is scattered into its constituents—quarks—resulting in the appearance of new particles which are detected in the measuring devices. Experts in the field are anticipating significant results concerning the structure of quarks and with it new knowledge about the particle group of the hadrons, which are all composed of quarks.

A central objective of particle physics is to unify the three interactions occurring in the microcosmos, the electromagnetic, the weak, and the strong force into a single force, to trace them down to a basic force. In this connection there are theories and model calculations which require the existence of new particles: for example, so-called leptoquarks, a symbiosis of leptons and quarks. Leptoquarks unite within themselves the characteristics of both quarks and leptons, which have previously been considered the fundamental particles of matter and are significantly distinct from each other in their properties. HERA offers the best potential to generate and detect such leptoquarks—if in fact they actually exist.

HERA is the only accelerator system in the world in which two different types of particles collide at different energies. (The energy of the protons is about 30 times greater than that of the electrons.) Other systems, for example, at the CERN [European Nuclear Research Center] near Geneva or Fermilab near Chicago work only with electrons or with protons (or the corresponding antiparticles), which always collide with each other at the same energy. HERA is thus a complex asymmetric machine. In an underground ring tunnel with a circumference of 6.3 km, two separate storage rings, which intersect each other at two points, are built. There the particles circling in HERA at almost the speed of light are directed against each other and forced into frontal collision. HERA is an instrument for basic research for experimental investigation of the structure of matter and the forces holding it together. DESY [German Electron Synchrotron] built this gigantic new device (total cost: 1.010 billion German marks; construction time: 6.5 years] with contributions from abroad (approx. 15 percent). The remaining investment costs were borne at the rate of 72 percent by the federal government (Federal Ministry for Research and Technology) and 13 percent from the city of Hamburg. Currently a total of 800 scientists from 16 nations are participating in particle physics research in the two groups H1 and Zeus.

TELECOMMUNICATIONS

Germany: Digital Mobile Telephone To Enter Market

92WS0572B Duesseldorf HANDELSBLATT in German 4 May 92 p 16

[Text]

RWTUeV Awards First Mobile Telephone License

Licenses for the first mobile telephone D network equipment, eagerly awaited at the German network operator Mannesmann Mobilfunk GmbH and elsewhere, will be awarded at the end of May by the RWTUeV [Rheinisch-Westfaelischer Technischer Ueberwachungsverein, Rhine-Westphalian Technical Control Board], Essen. The telephones could thus be on the market throughout Europe by the beginning of June, explained Dr. Hans-Juergen Meckelburg, director of the RWTUeV Institute for Information Technology, at the opening of the new quality center. The equipment from four manufacturers will receive certificates after each device undergoes 400 hours of testing in accordance with the European guidelines for electromagnetic compatibility (EMC).

Altogether, there are six testing centers throughout Europe. In Germany, in addition to the RWTUeV, the state-owned BFZ in Saarbruecken has jurisdiction and unconditionally recognizes the results of the TUeV institute. In Essen, meanwhile, 80 percent of the digital mobile telephones developed to date are on the test bench in the absorber hall (photo with the prototypes of the Siemens equipment).

"All of the 15 to 20 manufacturers world-wide are our clients; only the Japanese, with the exception of Panasonic, have not submitted anything yet," says Meckelburg. He sees the reason for this in special services. Employees of each manufacturer are accommodated in the Essen institute; they can immediately pass along all suggestions to their development departments. The RWTUeV charges at least 500,000 German marks [DM]

for one test. That is a small percentage of the development cost per telephone of DM20 to 40 million.

This innovative step was a gamble for the RWTUeV. The DM15 million information technology testing laboratory was the greatest single investment of the RWTUeV, which had a turnover of about DM420 million in 1991. Public funding is not available for the testing center. In three years only the DM6 million GSM systems simulator, which has now begun operation after a year's delay, will be amortized. For Meckelburg, however, this means that testing of the E1 network equipment must also be done at the RWTUeV.

The complexity of these new systems has always been underestimated, which, according to Meckelburg, accounts for the delays in the plans of the Federal Ministry of Post and Telecommunications. The Ministry planned for the network to begin operation by July 1991. This also applied to the simulator, which, in a cut-back interim solution, was working with fewer than 200 test programs. Therefore, the first licenses are also restricted until the end of the year. However, Meckelburg believes this period will have to be extended by a year.

Belgium: Alcatel-Bell Develops Multipurpose Image Codec

92BR0593 Paris ELECTRONIQUE INTERNATIONAL HEBDO in French 25 Jun 92 p 28

[Article by Francoise Grosvalet: "A Universal Video Codec for Broadband ISDN"]

[Text] Six standard-cell circuits and several standard components have enabled Alcatel Bell to integrate a universal image coder-decoder on a board based on the double Europe format.

Together with the Belgian design company SdM (Microelectronics Company) and the Catholic University of Louvain, Alcatel Bell has developed a range of six specific circuits intended for the development of a prototype universal video coder-decoder on a double Europe format board. This codec has been especially designed for transmitting coded digital TV signals along the broadband integrated-services digital network (B-ISDN). To this end, it is CCIR601/656-compatible for the transmission of digital TV signals at 216 Mbit/s. The interface for coded signals is compatible with the 155-Mbit/s ATM [asynchronous transfer mode] format recommended by the CCITT [Consultative Committee of International Telephone and Telegraph] for B-ISDN. The Alcatel Bell image codec will therefore be able to handle a wide range of video services, including studio-quality telecasting, high-quality video phone services, and the transmission of high-resolution still images. It is equally suited to interactive video and distributed video. Different quality levels and bit rates can be selected.

The universal image codec was developed at Alcatel Bell; SdM designed the six complex specific circuits required for signal coding and decoding. Besides these six circuits, the image codec comprises a standard DCT [discrete cosine transformer], memories, and a microcontroller. All these components have been integrated onto a double Europe format card.

One- and Two-Micron Standard Cell Circuits With On-Chip Memories

The YUV video components are processed in a single coding or decoding pipeline operating at 27 MHz. Each specific circuit is programmable via a serial or parallel interface so as to enable a choice between several image formats or types of application.

The first specific circuit, referred to as CIM, is an image controller which prepares the data for encoding (it actually transforms the lines into blocks). It also generates the synchronization signals for the other circuits and is reversible for decoding operations. This circuit can also perform filtering, subsampling, and horizontal interpolation functions. It has been produced using standard cell 1-micron CMOS [complementary metal-oxide semiconductor] technology and comprises 18,000 logical gates and 1.5 Kb of RAM [random-access memory].

At the heart of the image codec is the second specific circuit, dubbed FXP, which comes after the standard DCT. This circuit performs the inter- or intraframe adaptive linear quantification.

This circuit aims to reduce data redundancy or to eliminate data that is not visible. It automatically adapts to different image formats and can function equally well in coder or decoder mode. This circuit has also been produced in 1.2-micron standard cell technology and comprises 21,000 gates plus 4.5 Kb of RAM. The quantified coefficients are then applied on the universal variable-length coder (U-VLC) which performs the entropic coding.

The decoding part has been integrated onto another chip, called U-VLD [universal variable-length decoder], which performs the inverse function as well as resynchronization and eliminating transmission errors.

The coder and decoder have been developed in 1-micron standard cell technology. The coder comprises 28,000 gates and 10 Kb of RAM; the decoder comprises 32,000 gates and 13 Kb of RAM. A buffer block, abbreviated BRX, serves as an interface between the coder and decoder and the ATM channels.

This circuit also includes a control device which monitors buffer contents. It comprises 18,000 gates on a 1.2-micron standard cell circuit. Finally, the packet assembling circuit (PKX) establishes the ATM adaptive layer and reorganizes data in cells comprising 48 bytes plus 5 bytes for the header information (the format chosen for the ATM cells). This circuit has also been produced on 1-micron standard cell circuits and features 24,000 gates, 2.8 Kb of RAM, and 4.6 Kb of ROM [read-only memory]. All the circuits were manufactured by ES2 [European Silicon Structures]. Last 4 June, the

project earned the teams at SdM and Alcatel Bell the 1992 EuroAsic award, reserved for major enterprises.

Specialist Calls for High-Speed Data Network for Research

92WS0594 Munich COMPUTERWOCHE in German 29 May 92 p 8

[Article by Professor Dieter Haupt, Chairman of the Board, Association for the Promotion of a German Research Network]

[Text] No industrialized country should accept the decline of a key technology as an inevitable act of fate. The ever-increasing lead of the Japanese semiconductor industry over European competitors has become a much-discussed subject in the technical and financial press.

Much less in the public view, on the other hand, is the fact that the German Federal Republic is well on its way towards missing the boat in a further key technology. Today in the field of data communication, especially in the area of long-distance communications, a distinct lag behind the U.S. and Japan can already be noted. The present background conditions for telecommunications in Germany give rise to the fear, moreover, that the lag will quickly increase—with dramatic consequences for research, science, and the economy.

The doctrine of political economy has long regarded the availibility of efficient communication infrastructures as a factor of production which, along with the classical factors of soil, work, and capital, becomes increasingly important. When enterprises such as Volkswagen AG in Wolfsburg are thinking aloud about moving their telecommunication exchanges to European foreign countries, all those who are affected and responsible should be alarmed. It is high time to set the course for a telecommunications infrastructure which can stand up also in the long term to foreign comparison.

High-speed data networks with throughput rates of more than 100 Mb/s are already necessary today for special fields of application, and will become steadily more important for future applications of data communication.

To the extent that graphic user surfaces and new data-intensive applications (for example, picture processing, visualization, multimedia) will be developed as a result of improved computer performance, the demands on the transmission rates of data networks will also increase. The development and testing of these high-speed networks is one of the tasks of science, and in particular also of the Association for the Promotion of a German Research Network (the DFN Association), which, as a self-help organization of science, speaks for the interests of science in computer-oriented data communication.

Already in the present stage of development and testing, science in Germany must accept considerable disadvantages in its competition with other nations. Regulation by the Federal Ministry for Post and Telecommunications, which exists now as before, and the consequent management monopoly of telecommunications confronts German science with fees which are far higher than those of other countries, and exceed all limits of financeability. The situation is precarious—science cannot adequately fulfill its duty to society because it is prevented from doing so by outmoded background conditions.

Compared with Japan or with the U.S., where a 45-Mb/s network has already been constructed and is being constantlly expanded, and a "Gigabit Initiative" is in operation as a national project, the situation in Germany must be described as bleak. With isolated pilot projects in the range of 34 Mb/s, which are also greatly limited through high fees, a research and development of high-speed data transmission which approaches being realistic, is only possible as an initial stage. The requirement here is for high-speed segments of 100 to 500 Mb/s, in order to develop terminals and transmission equipment, as well to research the practical questions of effective distributed data processing systems.

Science and the DFN Association are ready to make their contribution towards safeguarding the situation of telecommunications in Germany—that is to say to develop high-speed technologies, to test them, and as first user to promote market development for them. The support of the DFN Association by the Federal Minister for Research and Technology, the Conference of the Prime Ministers of the Federal German States, the Conference of Ministers of Education and the Arts, and the Conference of University Rectors is encouraging, and allows us to hope for better background conditions in the future. It is high time!

Industry, Broadcasters To Cooperate in Developing D2-MAC Norm, 16/9 HDTV Format

92WS0660C Paris LE MONDE in French 19 Jun 92 p 16

[Article by Michel Colonna D'Istria: "Manufacturers and Broadcasters Join Forces to Promote High Definition Television"; first paragraph is LE MONDE introduction]

[Text] Representatives of 38 European companies involved in television approved an inter-industry agreement on Monday, 15 June in Brussels. The accord affirms their plans to promote the development of the D2-MAC standard and the 16/9 rectangular screen format, thus paving the way for European high-definition television (HDTV).

The memorandum had been prepared long before, under the aegis of the European Commission, as the third pillar of Europe's HDTV strategy. The other two are the directive on satellite broadcasting, which forces only new

broadcasters to adopt the D2-MAC starting in 1995, and the Commission's plan of action. But most of the concrete decisions concerning the financing of the plan (a five-year package of ECU600 million to ECU850 million) have been postponed until November (see LE MONDE 9 June). Only ECU33 million are available for 1992. And the signers of the memorandum—which is not legally binding—were careful to make its implementation conditional on "adequate funding." Furthermore, the text must still be ratified at the highest levels in each company, which is not a given everywhere.

These major reservations aside, the agreement represents "an important step in implementing advanced television in Europe," in the words of the European technologies commissioner, Mr. Filipo Maria Pandolfi. According to the French Postal and Telephones minister, Mr. Emile Zuccarelli, it gives "a true European dimension to the D2-MAC standard."

The Importance of the 16/9 Format

Signers of the memorandum include the continent's three principal manufacturers (Philips, Thomson, and Nokia), cable operators (including the Lyon and General Water Companies), satellite operators (including France Telecom and SES-Astra), and the main European broadcasters. The latter are A2 and Canal Plus in France, BBC and BSkyB in Great Britain, RTL-Plus, ARD, and ZDF in Germany, and RAI and Fininvest in Italy. The agreement remains open to other partners.

The signatories stress HDTV's "strategic importance." They would like to see rapid growth in satellite-television services and the 16/9 big-screen format. "In this context," the statement of principle reads, "the D2-MAC exists, and offers an immediate means of broadcasting to 16/9 format via satellite and cable." But, by request of the Germans in particular, the text as a whole emphasizes the 16/9 format over the D2-MAC. Satellite and cable network operators have therefore promised to provide sufficient broadcast capabilities, and manufacturers to market large quantities of receivers at attractive prices. Broadcasters are invited to produce programs adapted to those standards, and to prepare stations using the 16/9 format. To finance the projects submitted to it, the Commission will seek the counsel of a consortium to be formed by the signers of the memorandum.

The memorandum will be revised every two years to reflect results, and will remain effective "as long as the financial support provided for in the Community's plan of action is available." This clearly underscores the limits of the consensus: The 16/9 format, which is acknowledged the world over as the future of HDTV, is more important than the standard. Moreover, since neither the directive nor the industry agreement is very restrictive, subsidies are more crucial than ever in shifting from intentions to deeds and ensuring the success of the Commission's three-part plan.

European-Russian Telecommunications Joint Ventures

RTT/Belgacom, Alcatel Bell

92WS0678EE Chichester INTERNATIONAL TELECOMMUNICATIONS INTELLIGENCE in English 29 Jun 92 p 4

[Text] RTT/Belgacom and Alcatel Bell have again joined forces with Russian partners to create a new joint venture company that will be destined to improve international telecommunications between Moscow and the rest of the world.

The new company, the second in which Alcatel and Belgacom will be involved, will be called World Trade Telecom, and will be owned by the two Belgian companies, each with 15.5 percent of the capital, and by Sovincenter and Comincom, which will have 65 percent and 4 percent of the shares, respectively. The first joint venture company, Combellga—created by Comincom as the majority partner, itself a holding company within the Ministry of Foreign Affairs and majority-owned by the Russian commercial bank Orbita, Alcatel Bell, Belgacom and MGTS, the Moscow local PTT, in April 1991 (see *ITI* Issue 290)—is already operating in Russia and will provide World Trade Telecom with access to its existing infrastructure. It is hoped that World Trade Telecom will be operational by October 1992.

Signals will be transferred to Combellga's Alcatel 1000 S12 switch and from there to an earth station situated 30 km from Moscow. From that earth station signals will be transmitted via Intelsat to the Belgian earth station complex at Lessive. From there, they will be directed towards the International Alcatel 1000 S12 gateway operated by Belgacom in Brussels for transmission to the rest of the world.

Combellga was established to build an overlay network in Moscow to serve government and business customers with international requirements. At the announcement of its creation, Alcatel said that the network would be expected to serve 2,000 customers by the end of 1991. However, it now transpires that Combellga has only 450 subscribers, although monthly international traffic from Moscow continues to grow.

The distinction between the two companies is in the type of customers they will be serving and the geographical locations of those customers. Combellga is already serving customers in and around the Ministry of Foreign Affairs, primarily government offices, embassies, and a number of international hotels. Over and above these customers, Combellga's area of operation is only restricted to "the Moscow area." World Trade Telecom will be serving customers only around the Hammer Center, approximately 150-200 offices, two international hotels and "a limited number of apartments."

Sovincenter is an association of the customers who will be located within the operating area of World Trade Telecom.

France Telecom

92WS0678FF Chichester INTERNATIONAL TELECOMMUNICATIONS INTELLIGENCE in English 29 Jun 92 p 5

[Text] France Telecom announced its intention to enter the Russian domestic and international telecommunications market last week when it announced that it had signed a Memorandum of Understanding with the Russian company Zimland Telekom to form a joint-venture company before August 15 to provide telecommunications services in Russia.

Zimland Telekom comprises the different public telecommunications and broadcasting companies in the Kaliningrad Free-Trade Zone. It is licensed to provide telecommunications service in the Free Trade Zone and will, therefore, allow the new joint venture to become the operator for the entire region.

France Telecom said that network development will take place in two main phases, although an immediate initial phase will allow services to begin straight away. Initially, international access equipment is to be installed in Kaliningrad to provide international services to 200 subscribers. Following this, the first main phase will see the installation of ground earth station and its linkage to an international/national transit switch. This will allow 20,000 subscribers to be linked to the switch, including, France Telecom says, 2,000 businesses. Phase One will last 12 months.

During the second phase, France Telecom says, the existing public network will be renovated and expanded to allow 200,000 subscribers to be connected to the network.

The MoU is currently before Russian authorities awaiting approval.